FINAL REPORT
PHASES I AND II
ON AN
ABSOLUTE-TYPE PRESSURE SWITCH

FOR

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GEORGE C. MARSHALL SPACE FLIGHT CENTER
HUNTSVILLE, ALABAMA 35812

CONTRACT NO. NAS 8-20532

BY

THE BENDIX CORPORATION
FRIEZ INSTRUMENT DIVISION
BALTIMORE, MARYLAND 21204

Project No. 32-3024

July 1966

Bendix-Friez

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SUMMARY

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This report encompasses a review of the study phase (Phase I) and the prototype testing phase (Phase II) conducted by The Bendix Corporation on the development of an absolute-type pressure switch per Marshall Space Flight Center, Contract Number NAS 8-20532. The switch is a snap-action, single pole double throw type as specified in the Marshall Space Flight Center Drawing Number 20M32021.

The results of the study phase provided the necessary information required for selecting the materials, design of the linkage assembly, snap-action mechanism, diaphragms, adjustments and stops to be utilized in the prototype design of Phase II.

The results of the tests, conducted during Phase II, showed the prototypes to be satisfactory in the areas of bandwidth, differential pressure, repeatability, transfer time, circuit resistance, temperature compensation and dynamic temperature response. The prototypes under vibration and A.C. breakdown voltage were not satisfactory and will require additional consideration of the backfill pressure, linkage material, and balanced beam weight during Phase III. AUTHOR

Drawing number 1149999 in the Appendix shows the design of the switch at the close of Phase II.

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I. TECHNICAL DISCUSSION

A. INTRODUCTION.

In order to familiarize the reader with the scope of work performed thus far on this contract, a review of Phase I will be presented followed by the objectives and results of Phase II.

Inasmuch as a thorough report covering Phase I was submitted in February 1966 and approved, the following review of Phase I will be limited to a statement of work and the studies and testing performed to achieve these goals.

B. PHASE I REVIEW.

The primary goal of Phase I was to correlate theoretical and empirical information on each component of the four main elements; diaphragms, snap mechanism, springs and electrical contacts. The four main elements were combined into two elements - the diaphragms and the snap-action mechanism. The snap-action will be achieved by exceeding the latching forces of magnetic contacts with stored energy from a diaphragm which serves a dual function of sensing differentials in pressure and of supplying the spring force required to power the common contact within the specified time limits.

Most of the emphasis has been concentrated on magnetic latching and switching of three amperes since these areas contained the most unknowns. Theoretical and empirical studies on magnetic contacts were conducted and the following parameters were investigated:

Magnet material selection
Flux measurements
Magnet stability
Temperature tests on magnet materials
Contact materials
Contact configuration

Studies were made on the diaphragms to be used for both the system and calibration pressure sensing elements. System diaphragms of Ni Span-C alloy .006" and .008" thick, 1-1/4" diameter were tested to determine their spring rates, effective area and motion characteristics. Materials evaluated for the calibration diaphragms were .0015" Ni Span-C, .0015" beryllium copper, and .001" copper. A diaphragm stop must be incorporated into the design to protect the thin calibration shell from damage through repeated cycling. This stop diaphragm would contain the same convolution pattern and depth of draw to properly support the calibration diaphragm and would be .008" to .010" thick.

The linkage assembly consisting of the beam, pivot,and link from the beam to the system diaphragm were analyzed as to the material, configuration and weight. The common contact section of the beam must be of a magnetic material which is highly permeable with low retentivity such as Armco iron. The flexible pivot materials were fabricated from .003", .006", and .010" spring temper stainless steel. The best characteristics were obtained using the .006" thick material which was subjected to more than 10,000 flexures without deterioration. The link between the beam and system diaphragm used in the test model was .015" thick, .125" wide and was spot welded to the diaphragm and brazed to the counterbalance end of the beam.

Connectors were obtained from two sources for evaluation and are as follows:

Consolidated Electrodynamics Corporation
The Bendix Corporation - Scintilla Division

Environmental tests on these connectors were satisfactory and no leakage was detected through the pins or glass seal following welding and temperature testing.

The mechanical adjustment incorporated in the Phase II prototypes consisted of a differential screw, bellows, and compression spring. The bellows will prevent rotation of the differential mechanism's center screw and provide a hermetic seal for the setting mechanism. The compression spring will exert a force on the differential screw maintaining a positive setting during exposure to accelerations. Minor adjustments can be made with the differential screw to modify the operating point after the switch is completely sealed.

Temperature compensation of the switch can be achieved by two methods as follows:

1) A backfill gas to balance the effects of the mismatch in the thermal coefficients of expansion of mating materials.

2) Balance the thermal changes by the choice of materials used.

The study indicated the first method to be more feasible and a resulting positive backfill of 32.5 psia would be required to balance the system.

The following is a list of conclusions and recommendations based on the Study Phase:

a. The switch design presented in the proposal with minor modifications of relocating the external mechanical adjustment, magnetic contact

configuration, and sensing diaphragm orientation to the base is practical for the specified application.

b. Cast Alnico 5 alloys can withstand thermal shocks when cycled between the temperatures -450 °F and +300 °F.

c. The magnetic contacts can be stabilized with respect to the temperature and electrical environments to which they will be subjected.

d. Brazing Alnico 5 can be accomplished at temperatures up to 1250 °F without apparent structural damage. The absolute maximum temperature is 1300 °F.

e. Sufficient latching force is available with a silver plating thickness of .002 of an inch on the magnets and .0027 of an inch on the common contact.

f. Transfer time of less than 5 milliseconds can be achieved.

g. System diaphragms can be typical Ni Span-C diaphragms that have been manufactured previously.

h. Calibration diaphragms can be manufactured that will introduce only a slight variation in output readings.

i. The differential pressure between actuation and deactuation will vary with a change in latching force, air gap, and plating thickness.

j. Results of these characteristics (i.) are predictable.

k. Results concerning actuation and deactuation pressures are reproducible for a given set of conditions.

l. Plating thickness controls are critical to a successful operating pressure differential.

m. The pivot will always increase the spring rate of the system and decrease the output motion.

n. Adequate snap-action can be achieved in this design as proposed.

o. Mechanical linkage can withstand fatiguing stresses during the contact cycling.

p. Overpressures including the burst pressure should not affect the integrity of the hermetic seal.

q.. Three point suspension will prevent the introduction of undesirable stresses when mounting to the next assembly.

r. Pivot thickness of .006 of an inch appears to be the optimum thickness considering flexibility, manufacturing, and brazing and welding processes.

s. Mechanical stops are required to limit the diaphragm travel in both directions in order to prevent an overstressed switching linkage.

t. Mechanical stops must be adjustable.

u. Cast Alnico 5 magnet material is recommended for use in the pressure switch. The diameter should be .137 to .139 of an inch with a length to diameter, (L/D), ratio of 8. Fluxmeter readings should be in the range of 17 to 20 divisions of deflection.

v. The recommended contact configuration is a crossed cylinder arrangement which will provide point contact.

w. Based on the 3 ampere current load, the silver plated contacts are recommended as they exhibited a lower, more uniform, electrical resistance value, (0.11 ohms), then either the gold coated contacts, (0.2 to 0.24 ohms) or the bare Alnico 5 contacts, (0.26 ohms), due to the inherent high thermal conductivity of silver.

x. Beam ratio, (contact to pivot dimension vs. pivot to diaphragm link dimension), should be approximately 10 to 1 with provisions for varying the ratio over a range of 9.5 to 1 and 10.5 to 1.

y. Recommended operating pressure differential is between 36 to 60 millibars, at room temperature.

C. PHASE II OBJECTIVES.

The primary objective of Phase II was to design three prototype pressure switches based on the knowledge gained during Phase I. The three switches were to have actuation points of 23, 30, and 45 psia. Fabrication and testing of these switches to demonstrate the feasibility of these switches was to be accomplished during this phase. The evaluation tests conducted on the switches were as follows:

Dielectric Strength
Proof Pressure
Settings

Leakage
Insulation Resistance
Temperature Test (-320°F)
Temperature Shock
Vibration
Life Cycle
Temperature Test (-450 °F)

The results of the tests and a discussion of the data obtained from the evaluation tests are contained in Section II of this report.

1. SUPPLEMENTAL TESTING.

In addition to the evaluation tests, other tests were conducted to provide information, such as:

a. Calibration Diaphragm (.001") cycling.

b. Salt Spray Test.

c. Shock Test, Alnico 5 Magnet Material.

d. Dielectric Strength

1) .020" Ceramic Insulator (bottom magnetic contact).

2) .032" Ceramic Insulator (common contact).

CALIBRATION DIAPHRAGM CYCLING

The .001" thick calibration diaphragm was mounted in a test fixture containing a .006" system diaphragm. Sealing of the unit was accomplished with a rubber gasket. Pressure of 125 psig was applied to each side of the .001" diaphragm a total of 20 times followed by a cycle test at 85 psig. The cycle rate was 150 cycles/minute and a total of 100 cycles was applied to each side of the .001" diaphragm. Leak detection below 100 microns was not attained due to the method of assembly. Further tests were conducted with the system, calibration, and stop diaphragms soldered in the test fixture to insure proper sealing and to approximate conditions encountered in the prototype switches. Pressure of 135 psig was applied through each port (ten times) and the pressure was held for 5 minutes. No leaks were detected.

An additional 110 cycles at 135 psig were applied to each side of the calibration diaphragm with no leakage resulting. A total of 1245 cycles at pressures ranging from 85 psig to 135 psig were applied to the .001" diaphragm insuring confidence in the calibration diaphragms' ability to withstand the proof pressure, 115 psig, and the life cycle requirements of 0-75 psig.

SALT SPRAY TEST

Salt spray tests in accordance with MIL-E-5272, Procedure I, were performed on a test model to determine the effect of a 5% salt solution on the heliarc welded areas after a 50 hour exposure. The welded areas are around the electrical connector where it joints the cover, the cover and switch body joint, and the stop assembly in the base of the switch body.

There was no corrosion around any of the weld areas after 336 hours of exposure, although discoloration appeared in the area of the aluminum bronze differential screw after 50 hours. After 336 hours rust colored stains appeared around the connector terminal pin, the connector locking stud and the differential screw, but this was attributed to chamber residue which had formed in the cover of the test chamber and not a function of the component materials.

SHOCK TEST, ALNICO 5 MAGNET MATERIAL

Shock tests were conducted on Alnico 5 magnet materials to determine their ability to withstand mechanical shocks without change in the flux measurements.

The magnets .138"diameter, 1.1" long were soldered to brass bars .25" thick, 1/2" wide, 1-1/4" long providing an overhang consistent with the prototype design, to determine whether the magnets would crack at the end of the supporting surface. Four test pieces were used for testing to obtain a better sampling of the magnet material. A test piece was bolted to the shock machine and flux meter readings were recorded at the following accelerations:

Acceleration (G's)	Fluxmeter Readings (Divisions of Deflection)
23	12
40	12
50	12
60	12
90	12
110	12

Acceleration (G's) (cont)	Fluxmeter Readings (Divisions of Deflection) (cont)
240	12
360	12
530	12
600	12
620	12

Fluxmeter readings taken on the test samples prior to testing were of the same magnitude as those recorded after each shock.

Limitations of the test equipment precluded further testing above 620 G, but no magnetic deterioration was detected at this level. Tests were conducted in another plane which placed the acceleration force on the solder joint. The joint withstood the 620 G acceleration and flux meter readings were the same as previously recorded. Tests performed on the other three specimens produced similar results.

DIELECTRIC STRENGTH, CERAMIC INSULATORS

Dielectric strength measurements were conducted on the .020" thick ceramic which is used as an insulator between the bottom magnet and the bellows cap. Initial breakdown occurred at 1100 vac. The .032" thick ceramic insulator located between the common contact portion of the beam assembly and the counterbalance was tested and found to break down at 2000 vac. It must be noted that the test was conducted at sea level atmospheric pressure under high humidity conditions. Voltages exceeding these would be expected under dry conditions, although low backfill pressures have been found to lower the breakdown voltages considerably.

The voltage at which breakdown occurs can be increased in three ways as follows:

1) Increase the thickness of the ceramic insulator.

2) Mask the surface to limit the metallizing on the ceramic surface.

3) Increase the backfill pressure.

2. PROTOTYPE PROCESSING.

The prototype switches were processed in the following manner prior to performing the evaluation tests:

A. Cleaning.

1. Ultrasonic cleaning procedure.

a. Detergent cleaning agent conforming to MIL-D-16791 in demineralized water. Tank to contain recirculating system.

b. Rinse with demineralized water.

c. Vacuum dry.

d. Flush with trichloroethylene conforming to O-T-634 Type I or II or MIL-T-27602 Type I.

e. Purge with prefiltered nitrogen gas.

f. Vacuum dry.

2. Detergent Cleaning.

a. Using a nylon bristle brush, scrub with 0.5% detergent and water solution at a temperature of 122 °F ± 9 °F.

b. Flush with demineralized water 2 to 5 minutes.

c. Vacuum dry.

d. Flush with trichloroethylene conforming to O-T-634 Type I or II or MIL-T-27602 Type I.

e. Purge with prefiltered nitrogen gas.

f. Vacuum dry.

B. Brazing.

1. Furnace brazing, hydrogen atmosphere.

a. Prior to brazing, all parts are to be cleaned per method A1 or A2.

b. Braze bellows assembly, .006" system diaphragm, spacer ring, and pivot feet to the housing using BAg-7 preforms and wire. Furnace temperature 1340 °F.

NOTE: Diaphragm stop screw and spring must be inserted prior to brazing system diaphragm and bellows assembly.

c. Clean per method A1 or A2

d. Leak check (1.0 x 10^{-7} cubic cm H_e, max.)

e. Braze calibration diaphragm .001" using BAg-7. Furnace temperature 1340 °F.

f. Clean per method A1 or A2 to remove flux and foreign matter from cavity between system and calibration diaphragms.

g. Leak check.

C. Beam Assembly.

1. Counterbalance, Beam.

a. Braze counterbalance portion of beam to the pivot using BAg-7 braze.

NOTE: Fixture available for alignment.

2. Beam Bushing Assembly.

a. Apply Easy-flo 45 braze to one side of beam bushing assembly.

b. Pre-tin other side of beam bushing with solder, per QQ-S-571.

c. Clean beam bushing assembly to remove flux.

d. Heat contact side of counterbalance and insert brazed end of beam bushing assembly.

3. Common Contact.

a. Pre-tin the common contact with solder.

b. Clean to remove flux.

c. Place contact leaf on beam bushing.

d. Heat common contact and insert on beam bushing.

D. Stop Assembly, Calibration.

1. Heli-arc weld the stop assembly to the housing.

2. Leak check.

E. Magnet Assembly.

1. Pre-tin the following parts.

a. Magnets, side and ends.

b. Metallized ceramic pieces both sides. Use resin core solder.

c. Clean magnets to remove acid flux.

2. Assemble magnets and ceramic pieces.

NOTE: Fixture available for holding piece parts and for setting the gap.

3. Solder magnet assembly to bellows cover.

F. Set and Adjust Switches.

1. Set the 3 switches at 33.7 psia, 40.7 psia, and 55.7 psia respectively, for 23, 30, and 45 psia switch.

a. With the pressure applied, adjust system stop screw until it contacts system diaphragm; then back off 1/8 turn.

b. Adjust calibration stop screw until it just contacts the stop diaphragm; additional adjustment as follows:

1) 23 psia switch turn stop screw 1.4 revolutions, max.

2) 30 psia switch turn stop screw 1.5 revolutions, max.

3) 45 psia switch turn stop screw 1.7 revolutions, max.

c. Tighten the lock nut on the calibration stop screw.

d. While the pressure is on the system, braze the diaphragm link to the beam with Easy-flo 45.

e. Reduce pressure and check switching action.

NOTE: Additional adjustment may be required to the calibration stop to limit the return motion, but should be limited to .3 of a revolution clockwise on each switch.

f. Connect wires to the magnets, insulated terminal, connector terminals, and solder leaf to the insulated terminal.

G. Centrifuge.

1. Place the switches in the centrifuge and balance the beam assemblies.

NOTE: If actuation pressure decreases,then the counterbalance end of beam is light.

2. Cycle switch to determine bandwidth after balancing.

3. Clean switch assembly and heli-arc cover to housing.

4. Leak check cover assembly.

H. Backfill.

1. Evacuate the cavity under the cover and backfill with 278 MBS of nitrogen gas.

2. Reset differential screw if required.

I. Diaphragm Processing.

1. Exercise the system diaphragm by applying 120 psig through the system port of the switches as follows:

a. Switch #1 (23 psia).

1) 20 cycles at room temperature. Hold pressure for 7 minutes during the last 4 cycles.

2) 5 cycles at +165 °F. Hold pressure for 5 minutes.

3) 5 cycles at -320 °F. Hold pressure for 5 minutes.

b. Switch #2 (30 psia), repeat the above procedure.

c. Switch #3 (45 psia), repeat the above procedure.

3. EVALUATION TEST SEQUENCE.

The prototype switches were subjected to the evaluation tests outlined as follows:

A. Dielectric Strength - 1000 vac rms potential, 60 second duration.

1. From each terminal pin to the body of the switch.

2. Pin to pin, normally open set of contacts.

3. Between the terminal pins which are connected to the other contact after the switch is actuated.

B. Proof Pressure - 115 psig for 5 minutes.

1. System Port
2. Calibration Port

Record differential when increasing pressure to 115 psig and decreasing from 115 psig

C. Settings - Actuation-Deactuation, 3 cycles at the following test temperature: Room temperature, +165 °F, +125 °F, -320 °F.

1. System Port

a. Determine the actuation-deactuation pressure and differential pressure:

Allowable Differential Pressure

2 psi at -420 °F to -300 °F
1.5 psi at -300 °F to +125 °F
2 psi at +125 °F to +165 °F

b. Circuit resistance of 0.5 ohms max. when contacts are fully closed.

c. Response time - 5 milliseconds maximum.

2. Calibration Port.

a. Repeat C.1.a. and C.1.b.

D. Leakage.

1. Case - with switch in an evacuated container, case leakage shall be 1.0×10^{-7} cubic cms per second maximum of gaseous helium.

2. Cavities.

a. System - submerge switch in demineralized water for 10 minutes. Do not submerge the electrical connector: pressurize switch to 75 psig with helium. No formation of bubbles should be observed and no leakage between cavities.

b. Calibration - repeat procedure 2.a.

E. Insulation Resistance - 50 megohms at 500 vdc.

1. Each terminal pin to body of switch.

2. Between terminal pins when internal circuits are fully open.

F. Temperature Test - Switch to be stabilized at temperature indicated. Apply proof pressure, test B; perform setting test C.1.a., C.1.b. and C2.

1. Room temperature.

2. -320 °F (perform tests at beginning and end of 4 hour "soak").

3. +165 °F (perform tests at beginning and end of 24 hour "soak").

4. Stabilize switch at room temperature and perform tests.

a. Settings (less response time).

G. Temperature Shock.

1. Stabilize switch at +165 °F; insert base in liquid nitrogen and test continuously (determine the differential) using the system port until temperature stabilizes.

2. Examine and test at room temperature.

a. Settings (less response time).

H. Vibration.

1. Connect contacts to the coils of Struthers-Dunn #FC-1-181 relays

2. Monitor switch contacts and relay contacts with an oscillograph recorder.

3. Actuate-deactuate switch continuously from the system port during all periods of vibration.

4. Sinusoidal vibration.

a. Sinusoidal scan from 5 to 2000 to 5 cps at 1.0 octave per minute along each axis, (3). Levels as follows:

1) 5-38 cps at 0.4 inch double amplitude.

2) 38-2000 cps at 30 G peak.

5. Examine and test at room temperature.

a. Proof pressure.

b. Settings.

I. Life Cycle - total of 3500 cycles, 2500 cycles from system port, 1000 cycles from calibration port. Pressure cycle 75 psig to zero with 28 vdc, 3 amps resistive load applied to the closed contact. After each cycle phase that follows (1 through 9), the switches are to be tested at proof pressure test B, and settings test C.1.a., C.1.b., and C.2.

1. 500 cycles - system port at -320 °F 2. 250 cycles - calibration port at room temperature. 3. 500 cycles - system port at -320 °F. 4. 250 cycles - calibration port at room temperature. 5. 500 cycles - system port at +165 °F 6. 250 cycles - calibration port at room temperature. 7. 500 cycles - system port at room temperature. 8. 250 cycles - calibration port at room temperature. 9. 500 cycles - system port at room temperature.	1 Switch	2 switches All cycles thru system port only

J. Perform the following tests at -420 °F:

1. Setting, test C
2. Temperature, shock, test G.
3. Life cycle, test I,500 cycles (1 switch assembly).

II. RESULTS AND DISCUSSION OF TEST DATA, PHASE II.

In order to present the data obtained during the evaluation tests, summary pages have been prepared listing the tests performed on the three prototype switches. These summaries are located following this section on "Results and Discussion of Test Data", and appear as follows:

TABLE I. SUMMARY OF EVALUATION TESTS, 23 PSIA PROTOTYPE SWITCH
TABLE II. SUMMARY OF EVALUATION TESTS, 30 PSIA PROTOTYPE SWITCH
TABLE III. SUMMARY OF EVALUATION TESTS, 45 PSIA PROTOTYPE SWITCH

A discussion of each test performed on the prototype switches follows

A. ACTUATION-DEACTUATION BANDWIDTH.

Bandwidth is defined as the difference of the maximum actuation pressure and minimum deactuation pressure when the switch is tested over the temperature range of -420 °F to +165 °F.

Differential pressure is defined as the actuation-deactuation pressure at a particular temperature.

Preliminary tests were performed with 6 vdc, 40 ma applied to the switch contacts to determine the actuation-deactuation pressures through the system port of each of the switches at room temperature, -320 °F and +165 °F. The maximum bandwidths were .56 psid, 1.13 psid, and 1.30 psid for the 23, 30, and 45 psia switches, respectively, and the maximum differential pressure of .46 psid, 1.07 psid, and 1.30 psid were recorded at -320 °F for the three units. Pressure was applied to the calibration port of the 23 and 30 psia switch. The calibration diaphragm contributes an additional .90 to .94 psi to the bandwidth of the 23 psia switch and .58 to .62 psia for the 30 psia switch at room temperature. No reliable data was obtained for the 45 psia switch as a leak in the calibration diaphragm existed.

B. EVALUATION TESTS

1. DIELECTRIC STRENGTH.

Dielectric strength tests were performed on the 23, 30, 45 psia prototype switch. Specification requirements are 1000 vac rms for 60 seconds duration, from each terminal pin of the electrical connector to the body of the switch assembly, and between the terminal pins of the electrical connector when the internal circuits are fully open.

Breakdown occurred at 750 vac and 725 vac between #1 contact (pin A) and the switch body for the 23 and 30 psia switches respectively, and 675 vac between the common contact (pin C) and the switch body for the 45 psia switch. The lowest breakdown voltage recorded was 300 vac, 310 vac and 400 vac for the 23, 30, and 45 psia switches respectively.

Subsequent tests were performed with the cover removed from the 30 psia switch to determine the area where breakdown occurs. The unit was placed under a bell jar with a pressure of 213 mbs, and it was noted that breakdown occurred across the bottom ceramic insulator which separates #2 contact from the bellows cap. Also, breakdown of the air gap was observed.

A metallized ceramic insulator was tested at atmospheric pressure and the breakdown voltage across the 020" insulator was determined to be 1100 vac. Subsequent breakdown occurred at 650 vac.

2. INSULATION RESISTANCE.

Insulation resistance tests were conducted on all switches and in all cases the readings exceeded 3000 megohms resistance. Specification requirements are 5 megohms with 500 vdc applied to the switch assembly.

3. PROOF PRESSURE.

Proof pressure of 115 psig was applied to the system and calibration ports of the 23 and 30 psia switches. The deviation from the original set point for the 23 psia switch was less than .2 psi through the system and calibration ports.

Readings taken on the 30 psia switch indicate a deviation from the original readings of less than .1 psi through the system and calibration ports.

4. SETTINGS.

The switches were pressurized through the system port and readings were taken of the actuation-deactuation pressures at +165 °F and -320 °F to determine the bandwidth and differential pressure with 30 vdc, 50 ma applied to the contacts.

The maximum differential with pressure applied to the system port was .93, 1.3, and 1.51 psid for the 23, 30, and 45 psia switches over the temperature range of +165 °F to -320 °F.

The calibration port of the 23 and 30 psia switch was pressurized and the differential pressure recorded at .97 and 1.14 psid for the two switches. The maximum bandwidth for these switches considering both the system and calibration ports was .97 psid for the 23 psia switch and 1.62 psid for the 30 psia switch over the temperature range of +165 °F and -320 °F. Maximum contact resistance during the test was .4 ohms with 30 vdc, 50 ma applied to the contact, and the maximum transfer time was 4.5 msec

for the 23 and 30 psia switch. A maximum transfer time of 5.5 msec was observed for the 45 psia switch with the average being 4.5 to 5 msec over the temperature range. The larger air gap between the common contact and the magnetic contacts and the low current applied to the contacts contributes to the longer transfer time of this switch, as the transfer time with 3 amps applied is always less than 4 msec.

5. TEMPERATURE SHOCK.

The switch assemblies were subjected to a temperature shock cycle which consisted of stabilizing the switches at +165 °F then submerging the switches in liquid nitrogen at -320 °F. Actuation-deactuation pressures were continuously recorded through the system port between initial insertion and stabilization at -320°F.

The maximum differential pressures observed were .9, 1.6, and 1.55 psid and the maximum bandwidths were 1.42, 2.84, and 2.20 psi for the 23, 30, and 45 psia switches. The maximum contact resistance was .12 ohms, and the transfer time for the 23 psia switch was 3 msec.

6. TEMPERATURE TEST.

A temperature test was conducted at +165 °F and -320 °F with 28 vdc 3 amps applied to the contacts. Actuation-deactuation pressures applied to the system port were recorded at the beginning and end of a 24 hour soak at +165 °F and the beginning and end of a 4 hour soak at -320 °F temperature. The results are as follows:

Switch	Max. Δ P	Max. Bandwidth	Max. Resistance	Max. Transfer Time
23	1.03 psid	1.12 psid	.11 ohms	3.5 msec
30	1.58 psid	1.58 psid	.15 ohms	3.5 msec
45	2.03 psid	2.40 psid	.19 ohms	4 msec

The calibration port of the 30 psia switch was pressurized at -320 °F and the initial readings indicate a .24 to .64 psi contribution of the calibration diaphragm to the bandwidth which was reduced to .3 to .39 psi after a 7 hour soak at -320 °F.

7. VIBRATION.

Vibration tests were conducted on the three prototype switches. In an attempt to obtain data necessary for evaluating the performance of the switches under different conditions, the following parameters were imposed:

a. Vary the switching rate while vibrating the switch.

b. Vibrate the switch with the common contact at the "make point" with a magnetic contact.

c. Vibrate the switch while various overpressures ("hold") are applied.

d. Determine the effect of various "G" levels.

Specification requirements list both sinusoidal vibration and random vibration, but the evaluation tests were limited to sinusoidal due to the time element.

The normally open and closed contacts were connected to coils of relays, Struthers-Dunn FC-1-181 and the contacts of both the switch and relays were monitored with an oscillograph recorder. The recorder was equipped with galvanometers having a flat response of 0 to 3000 cps. Specification requirements are as follows:

Sinusoidal scan from 5 to 2000 to 5 cps at 1.0 octave per minute at the following levels:

a. 5 to 38 cps at .4 double amplitude.

b. 38 to 2000 cps at 30 G peak.

The following paragraphs will be devoted to a discussion of the tests in the sequence in which they were conducted.

The 30 psia switch with pressure applied to the system port was vibrated at 30 G's with a sinusoidal scan of 5 to 2000 cps at 1.0 octave/minute. The switching rate was 1 psi/18 sec in order to determine the actuation-deactuation pressure. The differential pressure ranged from .34 to .54 psid over the scan of 5 to 750 cps and increased from .75 to 1.6 psid between 750 to 2000 cps.

Chatter of the switch contacts was noted principally when the common contact was about to switch from one magnetic contact to the other. Table II lists the frequencies where chatter occurred. It is to be noted that in some instances, when chatter occurred with the switch contacts, the relay contacts "remained closed" indicating switch chatter was not of sufficient magnitude to drop the voltage across the relay coil opening the relay contacts. At other frequencies, when the relay contacts were "open", sufficient voltage was not present across the switch contacts (while chatter existed) to energize the relay coil. The term "chatter" in respect to relay contacts indicates they opened and closed during switch contact chatter. The relays were not vibrated.

The switching rate was increased to approximately 1 psi/2 sec and the number of frequencies where chatter existed was reduced.

The pressure between the common contact and #1 magnetic contact was increased, from its make point, to determine the pressure hold required to eliminate chatter. A scan was made from 5 to 2000 cps at 30 G's and a .55 pressure hold was required to eliminate chatter at 500 cps and a .7 psi hold was required at 800 cps. No other chatter frequencies existed up to 2000 cps.

The 23 psia switch was then vibrated under similar conditions with pressure holds of .5, 1, 1.5, 2, 2.5 psi between #1 contact and the common contact to confirm the chatter frequencies observed with the 30 psia switch. With a 1.0 octave/minute scan rate from 40 to 2000 cps at 30 G's, chatter was observed at 770 and 1300 cps with a pressure hold up to 1.5 psi but the relay contacts remained closed at the 770 cps frequency. Table I contains the vibration data in tabular form.

A manual scan was performed from 700 to 1500 cps to pinpoint the exact frequency and chatter was observed at 1270 cps. Increasing the pressure hold to 2 and 2.5 psi eliminated switch chatter except at the 1270 cps frequency although the relay contacts remained closed. The G force was reduced while maintaining a .5 psi pressure hold on #1 contact and it was determined that no contact or relay chatter existed at 10 G's, but chatter existed at the 1270 cps frequency with a 12 G input.

A resonance search was performed using the 23 psia switch with the common contact at the make point with the #1 magnetic contact. A scan from 100 to 5000 cps at 1, 5, and 10 G's input was made. Chatter occurred at 1270, 2250, 3700, 4700 cps, at 10 G's. At 5 G's, only very slight chatter at the 4700 cps frequency was observed.

The 45 psia switch was vibrated in two planes, (refer to Table III for tabulated data). The first plane (vertical) with the base of the switch bolted to the vibration exciter was vibrated at 30 G's with a scan from 5 to 2000 cps while the switch was actuated and deactuated at an average rate of 1 psi/30 seconds. Due to the slow switching rate, minor chatter existed as low as 260 cps as the common contact was about to transfer to the other magnetic contact, although the relay contacts remained closed. The differential pressure range was .43 to 2.20 psid over the scan of 5 to 1750 cps; the larger differentials existing in the frequency ranges where chatter existed. At 1800 cps, an additional 4 psi was applied to dampen the chatter. This increased pressure was required to fully close the contacts.

To check the data obtained with the 23 psia switch during the resonant search, the 45 psia switch was vibrated at 10 G's with a scan of 500 to 5000 cps and the common contact at the make point with the magnetic contact. Minor switch contact chatter existed at 1800 cps. At 2300 cps, contact chatter existed and the relay contacts opened. The absence of chatter at the 1270 cps frequency, noted in the other switches, can be attributed to the greater beam ratio (contact to pivot distance vs. pivot to link distance) existing in the 45 psia switch which utilizes the more effective magnetic latching force for damping purposes.

The second plane of vibration (horizontal), which the 45 psia switch was subjected to, was with the direction of vibration perpendicular to the system port. This placed the beam centerline 26° from the perpendicular plane to the direction of vibration. A scan of 5 to 2000 cps at 30 G's was conducted with the common contact switching between the magnetic contacts at 1 psi/24 sec. The differential pressure varied from .5 to 1.25 psi over the scan frequency of 5 to 1600 cps. Between the frequency range of 1600 to 1800 cps an overpressure of 4 psi would not dampen the existing chatter.

A discussion of testing performed to determine which switch components are causing chatter and the results of these tests will appear in Section II.C. following the remaining evaluation tests.

8. TEMPERATURE TEST, LIQUID HELIUM

A temperature test was conducted on the three prototype switches between room temperature and -450 °F, to determine the effects on the bandwidth, differential pressure and the component stability. Pressure was applied through the system port and actuation-deactuation readings recorded at room temperature. The switch assemblies were then immersed in liquid nitrogen to lower the switch temperature to -320 °F before flowing liquid helium into the container surrounding the pressure switch. Actuation-deactuation pressures and resistance measurements were recorded throughout the test.

The maximum bandwidths were 1.58, 1.72, and 2.3 psid for the 23, 30, and 45 psia switch assemblies, respectively. The maximum resistance recorded was .2 ohms and the transfer time was 3.5 msec.

While nearing completion of the helium temperature test on the 30 psia switch, erratic readings were observed. It was later found the switch had taken a permanent set in operating point from 29.72 psia to 8.62 psia at room temperature. The switch was retested and the maximum bandwidth had increased from 1.72 psid to 2.97 psid.

Subsequent investigation revealed that the braze joint where the beam is connected to the diaphragm link had cracked around the sides and bottom of the beam, although the braze was still intact at the top of the link, accounting for the change in operating point. Because the linkage assembly became more flexible when this occurred, the maximum bandwidth widened.

9. LIFE CYCLE, 3500 CYCLES

A life cycle test was conducted on the three prototype switches. The tests were limited to the system port as leaks existed in the calibration diaphragms (256 cycles through the calibration port of the 30 psia switch were obtained before the leak rate precluded further testing using the calibration port).

The life cycle test on the 30 psia switch was started and 756 cycles (500 cycles at -320 °F and 256 cycles at room temperature) were recorded prior to terminating the test to obtain vibration data. The test was to be completed following the helium temperature test but since the operating point shifted to 8.62 psid, the pressure cycle could not be utilized, and the reliability of the data would be questionable.

Life cycle testing was conducted using the 23 psia switch. The maximum bandwidth was .68 psid from the initial reading to the readings taken at 4550 cycles at room temperature. The bandwidth increased to 75 psid following an additional 880 cycles at -320 °F (5330 cycles). Circuit resistance during the test was .11 ohms and the contact transfer time recorded at 2 msec.

The life cycle test conducted on the 45 psia switch included 550 cycles at +165 °F, 2427 cycles at room temperature, 500 cycles at -320°F and 313 cycles at -450 °F. The tabulated results are listed in Table III. The maximum differential pressures at room temperature are as follows:

Initial Differential Pressure = 1.20 psid
Differential Pressure at 3790 cycles = 1.41 psid

An additional 6810 cycles were performed on the switch and the maximum differential pressure of 1.55 psid existed when the test was terminated at 10,600 cycles. Maximum resistance measurements throughout the test were .12 ohms and transfer time was less than 3 msec.

C. VIBRATION ANALYSIS OF SWITCH COMPONENTS.

Subsequent testing was conducted on the pressure switches in an attempt to determine the components causing switch chatter. The major areas of investigation were:

1. Magnet assembly consisting of:

   a. Bellows.

   b. Spring.

   c. Differential screw.

2. Beam assembly.

3. Pivot.

4. Leaf from the common contact to the insulated terminal.

5. Diaphragm link.

6. System diaphragm.

The covers were removed from the 30 and 45 psia switches so that the various components could be observed and probed while the switches were vibrated.

Tests were conducted with the spring under load and with the spring compressed to its solid height and switch chatter existed between 2450 and 2500 cps in both cases at 20 G's with a scan from 100 to 3000 cps. Minor chatter existed at 2100 cps with the spring under load. No other chatter frequencies were observed. The 2475 cps frequency was by far the most severe and while vibrating in this range the various switch components were probed. The displacement of the beam was more pronounced than the terminal leaf, diaphragm, or link and the chatter was easily damped by probing the pivot.

The terminal leaf was removed from the common contact but no change in the chatter frequency of 2475 was observed. While vibrating between 2400 and 2500 cps, the diaphragm was probed. Switching of the common contact was achieved by pushing on the diaphragm with the probe and chatter still existed at the contacts indicating the diaphragm was not exciting the linkage assembly.

From previous experience, it has been found that diaphragm vibration can be dampened easily by contacting it with a probe when it goes into resonance, thus, indicating the beam and pivot were the exciting components.

In an attempt to verify whether the beam and pivot assembly were the primary components causing chatter, a test model was vibrated which contained a pivot

and beam assembly without the diaphragm and link attached. A brass contact was mounted in the test model instead of a magnetic contact. The common contact of the beam assembly was in contact with the brass contact and a scan from 600 to 2900 cps at 1G was made. At 2500 cps, the beam and pivot combination went into resonance, but no other chatter frequencies were detected. At 3 G's, chatter frequencies were detected at 1225 and 2500 cps, and 6 G's were required to produce chatter at 775 cps as well as the 1225 and 2500 cps frequencies.

Further testing was performed using the test model with a system diaphragm and link combination only. It was found that the resonant frequence of the diaphragm with link attached was 3150 to 3200 cps.

It has been concluded from these tests that the components excited at the critical frequencies of 775, 1270, and 2475 cps are the beam and pivot.

D. CALIBRATION DIAPHRAGM.

The calibration diaphragms, when brazed in the switch housings, were leak free when checked on the helium leak detector. Preliminary tests were performed on the switches including 20 cycles through the system port at 120 psig with the pressure held for 5 minutes during the last four cycles, and 50 actuation-deactuation cycles before a leak of .02 psi/min. was detected in the calibration diaphragm of the 30 psia switch. The 45 psia switch calibration diaphragm leaked after 15 cycles at 121 psig, but no leakage was detected with the 23 psia switch until temperature testing was performed.

Confidence in the ability of the .001" diaphragm to withstand the proof pressure and setting pressures had been gained in earlier tests performed on this material, but with the diaphragm brazed in the prototype its performance was quite limited.

It appears at this time that failure of the calibration diaphragm can be attributed to either the hydrogen furnace brazing process or cleaning of the cavity following the brazing operation.

Brazing of the calibration diaphragm was accomplished at a temperature of 1340 °F, but the rate at which the unit entered and left the heat zone differed which could have produced stresses in the outer convolution. The different rates of cooling between the thin calibration shell and the switch body can be aided by reducing the speed of the belt during the brazing operation and reducing the furnace temperature.

The other possible cause of failure could have been the result of a small piece of brazing flux remaining in the cavity between the system and calibration shell. In future units, a thin water coat solution of flux will be used to eliminate the possibility of flux particles becoming trapped between the diaphragms.

Through proper processing, it is believed that integrity of the calibration diaphragm can be achieved.

TABLE I. SUMMARY OF EVALUATION TESTS, 23 PSIA PROTOTYPE SWITCH

Actuation-Deactuation — Final Backfill of 186.5 mb with 6 vdc, 40 ma applied

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP
System Port			
-320°F (20 min)	▷ 22.62 psia	23.08 psia	.46 psid
Room	22.63 psia	23.05 psia	.42 psid
+165°F	22.79 psia	▷ 23.18 psia	.39 psid

Bandwidth, max. = .56 psid

Actuation-Deactuation

System Port at room temp.			
	▷ 22.65 psia	23.02 psia	.37 psid
Calib. Port at room temp.			
	23.59 psia	▷ 23.92 psia	.33 psid

Bandwidth, max. = 1.27 psid (.94 psi contribution from calibration diaphragm)

Dielectric Strength:

Lowest breakdown voltage; 300 vac, #2 contact and common contact

Highest breakdown voltage; 750 vac, #1 contact and switch body

Insulation Resistance: 500 vdc, 5 megohms

Common contact to case: 3,000 megohms
#1 contact (Pin A) to case: 5,000 megohms
#2 contact (Pin B) to case: 10,000 megohms
#1 contact to common contact: infinite resistance
#2 contact to common contact: infinite resistance

TABLE I. SUMMARY OF EVALUATION TESTS, 23 PSIA PROTOTYPE SWITCH (CONT'D)

Proof Pressure: 115 PSIG, Actuation-Deactuation Pressures at room temp.

	#1 Contact	#2 Contact	ΔP
System Port	22.5 psia	22.8 psia	.3 psid
Calibration Port	22.7 psia	23.9 psia	1.2 psid

Settings: Actuation-Deactuation pressure from +165°F to -320°F with 30 vdc, 50 ma applied

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP	Maximum Resistance	Max. Transfer Time
System Port	22.32 psia	23.25 psia	.93 psid	.2 ohms	4.5 msec
Calibration Port	▷ 22.30 psia	▷ 23.27 psia	.97 psid	.3 ohms	4.5 msec

Bandwidth, max. = .97 psid

Temperature Shock +165°F to -320°F with 28 vdc, 3 amps applied

	#1 Contact	#2 Contact	Max. ΔP	Maximum Resistance	Max. Transfer Time
170°F	22.78 psia	23.65 psia	.87 psid	.09 ohms	2.5 msec
-320°F (initial insertion)	23.38 psia	▷ 23.90 psia	.52 psid	.09 ohms	
-320°F (after stabilization)	▷ 22.48 psia	23.40 psia	.90 psid	.09 ohms	3 msec

Bandwidth, max. = 1.42 psid

Temperature Test +165°F (24 hours) to -320°F (4 hours) with 28 vdc, 3 amps applied

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP	Maximum Resistance	Max. Transfer Time
+165°F (24 hr. soak)					
Initial	22.65 psia	▷ 23.31 psia	.66 psid	.11 ohms	
Final	22.49 psia	23.11 psia	.62 psid	.11 ohms	3.5 msec

TABLE I. SUMMARY OF EVALUATION TESTS, 23 PSIA PROTOTYPE SWITCH (CONT'D)

Temperature Test (Cont'd)

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. Δ P	Maximum Resistance	Max. Transfer Time
-320°F After 5 hr. soak	▷ 22.19 psia	23.22 psia	1.03 psid	.11 ohms	3.5 msec

Bandwidth, max. = 1.12 psid

Vibration — Sinusoidal Scan 5 to 2000 to 5 cps at 1.0 octave/min.

Levels:

1. 5 to 38 cps at .4" D.A.
2. 38 to 2000 cps at 30G peak

Common contact on #1 contact with the make point at 22.40 psia

Scan from 40 to 2000 cps at 30 G's

Pressure Hold on #1 Contact	Frequency, CPS	Switch Contact #1	Relay #1 Contacts
0.5 psi	770	Chatter	Remained closed
0.5 psi	1300	Chatter	Chatter
1.0 psi	770	Chatter (minor)	Remained closed
1.0 psi	1300	Chatter	Chatter
1.5 psi (manual scan)	770	Chatter (minor)	Remained closed
1.5 psi	1270	Chatter	Chatter
2.0 psi	1270	Chatter	Remained closed
2.5 psi	1270	Chatter	Remained closed

Scan from 700 to 1500 cps with common contact on #1 contact

"G" Level	Pressure Hold on #1 Contact	Frequency, CPS	Switch Contact #1	Relay #1 Contacts
20	0.5 psi	1270	Chatter	Chatter
5	0.5 psi	No chatter from 700-1500		Remained closed
12	0.5 psi	1270	Chatter	
10	0.5 psi	No chatter from 700-1500		Remained closed

TABLE I. SUMMARY OF EVALUATION TESTS, 23 PSIA PROTOTYPE SWITCH (CONT'D)

Resonance Search

"G" Level	Scan Frequency	Switch Contact	Relay #1 Contacts	Switch Contact Chatter Frequency
1	500 to 5000 cps	#1 at .05 psi hold	Remained Closed	
5	500 to 5000 cps	#1 at .05 psi hold	Remained Closed	4700 cps
10	500 to 5000 cps	#1 at .05 psi hold	Remained Closed	2250 cps
			Remained Closed	4700 cps
10	100 to 5000 cps	#1 at make point	Chatter, Open	1270 cps
		#1 at make point	Chatter, Open	2250 cps
		#1 at make point	Chatter, Open	3700 cps
		#1 at make point	Chatter, Open	4700 cps

Temperature Test, Liquid Helium

Actuation-Deactuation pressure at room temperature, -320°F, -450°F with 28 VDC, 3 amps applied.

System Port	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP	Maximum Resistance
Room	22.60 psia	22.98 psia	.38 psid	.1 ohm
-320°F	21.68 psia	▷23.18 psia	1.5 psid	
-450°F	▷21.60 psia	22.65 psia	1.05 psid	

Bandwidth, max. = 1.58 psid

Life Cycle, 3500 cycles

System Port	#1 Contact	#2 Contact	ΔP	Resistance	Transfer Time
Room (initial)	▷22.32 psia	22.82 psia	.5 psid	.11 ohms	2 msec
Room (4450 cycles)	22.32 psia	▷23.00 psia	.68 psid	.11 ohms	2 msec
Room (after 880 cycles at -320°F 5330 cycles)	▷22.25 psia	22.93 psia	.68 psid		2 msec

Bandwidth, max. = .68 psid (initial reading to 4450 cycles)

Bandwidth, max. = .75 psid

TABLE II. SUMMARY OF EVALUATION TESTS, 30 PSIA PROTOTYPE SWITCH

Actuation-Deactuation — Final Backfill of 213 mb with 6 vdc, 40 ma applied

	Lowest Reading #1 Contact	Highest Reading #2 Contact	ΔP
System Port			
-320°F (30 min)	▷28.95 psia	30.02 psia	1.07 psid
Room	29.45 psia	30.00 psia	.55 psid
+165°F	29.55 psia	▷30.08 psia	.53 psid

Bandwidth, max. = 1.13 psid

Actuation-Deactuation

System Port at room temp.	▷29.44 psia	30.01 psia	.57 psid
Calibration Port at room temp.	30.06 psia	▷30.58 psia	.52 psid

Bandwidth, max. = 1.14 psid (.62 psi contribution from calibration diaphragm)

Dielectric Strength

Lowest Breakdown Voltage, 310 vac, #2 contact and common contact

Highest Breakdown Voltage, 725 vac, #1 contact and switch body

Insulation Resistance: 500 VDC, 5 megohms

Common contact to case: Infinite Resistance
#1 Contact (Pin A) to case: Infinite Resistance
#2 Contact (Pin B) to case: Infinite Resistance
#1 Contact to common contact: Infinite Resistance
#2 Contact to common contact: Infinite Resistance

Proof Pressure — 115 PSIG, actuation-deactuation pressures at room temp.

	#1 Contact	#2 Contact	ΔP
System Port	29.5 psia	30.0 psia	.5 psid
Calibration Port	30.1 psia	30.6 psia	.5 psid

TABLE II. SUMMARY OF EVALUATION TESTS, 30 PSIA PROTOTYPE SWITCH (CONT'D)

Settings: Actuation-Deactuation Pressure from +165°F to -320°F with 30 VDC, 50 MA applied

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. Δ P	Maximum Resistance	Max. Transfer Time
System Port	▷ 28.60 psia	29.90 psia	1.3 psid	.4 ohms	4 msec
Calibration Port	29.08 psia	▷ 30.22 psia	1.14 psid	.26 ohms	4.5msec

Bandwidth, max. = 1.62 psid

Actuation-Deactuation Pressure at room temperature with 28 VDC 3 amps applied

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. Δ P	Maximum Resistance	Max. Transfer Time
System Port	▷ 29.22 psia	29.90 psia	.68 psid	.12 ohms	3.5 msec
Calibration Port	29.56 psia	▷ 30.20 psia	.64 psid	.12 ohms	3.5 msec

Bandwidth, max. = .98 psid

Temperature Shock: +165°F to -320°F with 20 VDC 2.2 amps applied

	#1 Contact	#2 Contact	Max. Δ P	Maximum Resistance
+165°F	28.98 psia	29.80 psia	.82 psid	.1 ohm
-320°F (initial insertion)	29.90 psia	▷ 30.69 psia	.79 psid	.1 ohm
-320°F (after stabilization)	▷ 27.85 psia	29.45 psia	1.6 psid	.12 ohm

Bandwidth, max. = 2.84 psid

TABLE II. SUMMARY OF EVALUATION TESTS, 30 PSIA PROTOTYPE SWITCH (CONT'D)

Temperature Test: +165°F (24 hours) to -320°F (4 hours) with 28 VDC 3 amps applied

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP	Maximum Resistance	Max. Transfer Time
System Port					
+165°F (24 hour soak)					
Initial	29.01 psia	29.91 psia	.9 psid	.1 ohm	2 msec
Final	28.98 psia	29.86 psia	.88 psid	.1 ohm	2.5 msec
-320°F (7 hour soak)					
Initial	▷28.50 psia	▷30.08 psia	1.58 psid	.15 ohm	3.5 msec
Final	28.50 psia	29.88 psia	1.38 psid	.15 ohm	3 msec

Bandwidth, max. = 1.58 psid

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP	Maximum Resistance	Max. Transfer Time
Calibration Port					
-320°F (7 hour soak)					
Initial	29.14 psia	30.32 psia	1.18 psid	.1 ohms	2.5 msec
Final	28.89 psia	30.18 psia	1.29 psid	.15 ohms	3.5 msec

Life Cycle 3500 cycles

	#1 Contact	#2 Contact	ΔP	Resistance	Transfer Time
Calibration Port					
Room (initial)	29.05 psia	29.80 psia	.82 psid	.1 ohm	3 msec
Room (256 cycles)	29.15 psia	30.09 psia	.94 psid	.11 ohms	4 msec
System Port					
-320°F (500 cycles)	28.52 psia	29.79 psia	1.27 psid	.1 ohms	3 msec

(Test terminated to obtain vibration data)

TABLE II. SUMMARY OF EVALUATION TESTS, 30 PSIA PROTOTYPE SWITCH (CONT'D)

Vibration Sinusoidal Scan 5 to 2000 to 5 cps at 1.0 octave/min.

Levels:

1. 5 to 38 cps at .4" D.A.
2. 28 to 2000 cps at 30G peak

Common contact switching from #1 to #2 contact. Switching rate 1 psi/18 sec.

Scan 5 to 2000 cps at 30 G's

Frequency, CPS	#1 Contact	#2 Contact	Relay #1 Contacts	Relay #2 Contacts
440		Chatter		Remained closed
750		Chatter		Open
1270	Chatter		Chatter	
1400		Chatter		Open
1650	Chatter		Open	
1800		Chatter		Open
2000	Chatter		Open	

Scan from 2000 to 5 cps at 30 G's. Switching rate approximately 1 psi/2 sec.

Frequency, CPS	#1 Contact	#2 Contact	Relay #1 Contacts	Relay #2 Contacts
1850		Chatter		Remained closed
1500	Chatter		Open	
1270	Chatter		Open	
770		Chatter		Open
380	Chatter		Remained closed	

Common contact on #1 contact. Increase pressure on #1 contact to dampen out chatter.

Scan 5 to 2000 cps 30 G's

Frequency, CPS	#1 Contact	Pressure	Pressure Hold	Relay #1 Contacts
0		29.30 psid	0	
500	Chatter	28.75 psia	.55 psi	Remained closed
800	Chatter	28.60 psia	.7 psi	Chatter

TABLE II. SUMMARY OF EVALUATION TESTS, 30 PSIA PROTOTYPE SWITCH (CONT'D)

Temperature Test, Liquid Helium

Actuation-Deactuation pressure at room temperature, -320°F, -450°F with 30 VDC, 3.2 amps applied.

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP	Maximum Resistance
System Port				
Room	29.08 psia	▷29.72 psia	.64 psid	.19 ohms
-320°F	28.10 psia	29.45 psia	1.35 psid	.2 ohms
-450°F	▷28.00 psia	29.50 psia	1.50 psid	.15 ohms

Bandwidth, max. = 1.72 psid

Set Point Shift: Re-test

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP	Maximum Resistance
Room	7.52 psia	▷8.62 psia	1.1 psid	.11 ohms
-320°F	6.25 psia	8.25 psia	2 psid	.1 ohms
-450°F	▷5.65 psia	7.90 psia	2.25 psid	.15 ohms

Bandwidth, max. = 2.97 psid

TABLE III. SUMMARY OF EVALUATION TESTS, 45 PSIA PROTOTYPE SWITCH

A restriction in the setting mechanism precluded setting of the switch @ 45 psia.

Actuation-Deactuation Pressure — Final Backfill of 91 mbs with 6 vdc, 40 ma applied

System Port	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. Δ P
-320°F	▷41.25 psia	▷42.55 psia	1.30 psid
Room	41.48 psia	42.50 psia	1.02 psid
+165°F	41.61 psia	42.51 psia	.90 psid

Bandwidth, max. = 1.30 psid

Dielectric Strength:

Lowest Breakdown Voltage; 400 vac, #2 Contact to Switch Body
400 vac, #2 Contact to Common Contact
400 vac, #1 Contact to Common Contact

Highest Breakdown Voltage; 675 vac, Common Contact to Switch Body

Insulation Resistance: 500 vdc, 5 megohms

Common Contact to Case: Infinite Resistance
#1 Contact (Pin A) to Case: Infinite Resistance
#2 Contact (Pin B) to Case: Infinite Resistance
#1 Contact to Common Contact: Infinite Resistance
#2 Contact to Common Contact: Infinite Resistance

Proof Pressure: 115 psig, Actuation-Deactuation Pressures at Room Temperature

	#1 Contact	#2 Contact	Δ P
System Port	41.6 psia	42.12 psia	.52 psid

TABLE III. SUMMARY OF EVALUATION TESTS, 45 PSIA PROTOTYPE SWITCH (CONT'D)

Settings: Actuation-Deactuation Pressure from +165°F to -320°F with 30 vdc, 50 ma applied.

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP	Maximum Resistance	Max. Transfer Time
System Port	40.88 psia	42.39 psia	1.51 psid	.26 ohms	5.5 msec

Temperature Shock: +165°F to -320°F with 20 vdc, 2.2 amps applied

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP	Maximum Resistance	Max. Transfer Time
+165°F	40.80 psia	41.88 psia	1.08 psid	.1 ohms	
-320°F (initial insertion)	41.62 psia	▷42.65 psia	1.03 psid	.1 ohms	
-320°F (after stabilization)	▷40.45 psia	42.00 psia	1.55 psid	.1 ohms	

Bandwidth, max. = 2.20 psid

Temperature Test: +165°F (24 hours) to -320°F (4 hours) with 30 vdc, 3 amps applied

	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. ΔP	Maximum Resistance	Max. Transfer Time
+165°F (24 hour soak)					
Initial	40.76 psia	41.80 psia	1.04 psid	.12 ohms	4 msec
Final	▷40.25 psia	41.30 psia	1.05 psid	.11 ohms	3.5 msec
-320°F (4 hour soak)					
Initial	41.62 psia	▷42.65 psia	1.03 psid	.1 ohms	4 msec
Final	40.42 psia	42.45 psia	2.03 psid	.19 ohms	3.5 msec

Bandwidth, max. = 2.40 psid

TABLE III. SUMMARY OF EVALUATION TESTS, 45 PSIA PROTOTYPE SWITCH (CONT'D)

Vibration Sinusoidal Scan 5 to 2000 to 5 cps at 1.0 octave/min.

Levels:

1. 5 to 38 cps at .4" D.A.
2. 38 to 2000 cps at 30G peak

Common contact switching from #1 to #2 contact

Scan from 5 to 2000 cps at 30G's (vertical axis). Switching rate 1 psi/30 sec.

Frequency, CPS	#1 Contact	#2 Contact	Relay #1 Contacts	Relay #2 Contacts
260		Chatter		Remained closed
360		Chatter		Remained closed
460	Chatter		Remained closed	
600		Chatter		Open
680		Chatter		Open
750	Chatter		Chatter	
820		Chatter		Open
1200.		Chatter		Open
1500		Chatter		Open
1750-1850	Chatter		Open	

Common contact on #2 contact only with pressure applied to dampen contact chatter.

Scan 2000 to 5 cps at 30 G's (vertical axis)

Frequency, CPS	#2 Contact	Pressure	Pressure Hold	Relay #2 Contacts
1800-	Chatter	42.50 psia	1 psi	Chatter, open
1750-1600	Chatter		1 psi	Chatter, open
1500	Chatter		1 psi	Open
1200	Chatter		1 psi	Remained closed
600	Chatter		1 psi	Remained closed
0		41.50 psia		

TABLE III. SUMMARY OF EVALUATION TESTS, 45 PSIA PROTOTYPE SWITCH (CONT'D)

Vibration (Cont'd)

Scan from 500 to 5000 cps at 10 G's (vertical axis) common contact on #2 contact at the make point, (no overpressure).

Frequency, CPS	#2 Contact	Relay #2 Contact
1800	Chatter	Remained closed
2250-2350	Chatter	Chatter, open
2350-2500	Chatter	Remained closed
3800	Chatter	Remained closed
4300	Chatter	Remained closed

Common contact switching from #1 to #2 contact. Switching rate 1 psi/24 sec.

Scan 5 to 2000 to 5 cps at 30 G's (horizontal axis, perpendicular to the system port).

Frequency, CPS	#1 Contact	#2 Contact	Relay #1 Contacts	Relay #2 Contacts
73		Chatter (minor)		Chatter (minor)
145		Chatter (minor)		Chatter (minor)
600		Chatter		Chatter
690		Chatter		Chatter, open
800		Chatter		Chatter, open
1150		Chatter (minor)		Chatter (minor)
1300		Chatter		Chatter
1400	Chatter		Remained closed	
1500		Chatter		Remained closed
1650-1800	Chatter	Chatter	Open	Open
1900	Chatter		Open	

Scan 2000 to 5 cps at 30 G's
Switching rate 1 psi/16 sec, 2000 to 1000 cps; 1 psi/8 sec., 1000 to 450 cps

1950	Chatter		Open	
1800-1650		Chatter		Open
1550		Chatter		Chatter
1270	Chatter		Open	
1150	Chatter		Open	
800		Chatter		Open
570-600	Chatter	Chatter	Chatter	Open

Switching rate 1 psi/2 sec from 450 to 5 cps

380		Chatter (minor)		Remained closed

TABLE III. SUMMARY OF EVALUATION TESTS, 45 PSIA PROTOTYPE SWITCH (CONT'D)

Vibration (Cont'd)

Scan 500 to 2000 cps at 30 G's with common contact on #2 contact

Frequency, CPS	#2 Contact	Relay #2 Contact
575	Chatter	Open
1500-1800	Chatter	Open

Temperature Test, Liquid Helium

Actuation-Deactuation Pressure at Room Temp., -320°F, -450°F with 28 vdc, 3 amps applied.

System Port	Lowest Reading #1 Contact	Highest Reading #2 Contact	Max. Δ P	Maximum Resistance	Max. Transfer Time
Room	41.30 psia	42.58 psia	1.28 psia	.1 ohms	
-320°F	40.76 psia	42.38 psia	1.62 psia	.11 ohms	
-450°F	▷40.60 psia	▷42.90 psia	2.3 psia	.13 ohms	3.5 msec

Bandwidth, max. = 2.3 psid

Life Cycle: 3500 Cycles

System Port

Temperature and Cycles	Cycles, Total	#1 Contact	#2 Contact	Δ P	Resistance	Transfer Time
Room (initial)		41.45 psia	42.65 psia	1.20 psid	.12 ohms	2.5 msec
-320°F (500)	500					2 msec
-452°F (313)	813					2 msec
Room Return		41.50 psia	42.70 psia	1.20 psid	.11 ohms	
+165°F (550)	1363	41.50 psia	42.80 psia	1.30 psid	.11 ohms	3 msec
Room (727)	2090	41.38 psia	42.68 psia	1.30 psid	.11 ohms	3 msec
Room (500)	2590	41.30 psia	42.70 psia	1.40 psid	.11 ohms	3 msec
Room (1200)	3790	▷41.32 psia	▷42.73 psia	1.41 psid	.11 ohms	3 msec
Room (2010)	5800	41.30 psia	42.72 psia	1.42 psid	.11 ohms	3 msec
Room (1620)	7420	41.30 psia	42.85 psia	1.55 psid	.11 ohms	3 msec
Room (2580)	10,000	41.32 psia	42.85 psia	1.53 psid	.12 ohms	3 msec
Room (600)	10,600	▷41.30 psia	▷42.85 psia	1.55 psid	.12 ohms	3 msec

Max. Δ P = 1.41 psid (reading @ 3790 cycles)

Max. Δ P = 1.55 psid (final reading @ 10,600 cycles)

III. CONCLUSIONS AND RECOMMENDATIONS, PHASE II

The following is a list of conclusions and recommendations based on the test results obtained during Phase II testing of 3 prototype pressure switches.

CONCLUSIONS:

1. The .001" calibration diaphragm increases the maximum bandwidth by .62 to .94 psid at room temperature.

2. The magnets can withstand 600 G shocks with no detectable magnetic deterioration.

3. Mechanical stops will prevent overstressing the linkage system.

4. A total of 10,600 cycles was achieved with only a .35 psi increase in differential pressure with the existing switch design.

5. Plating thickness on the magnets and common contact can be reduced,thereby increasing the magnetic latching force.

6. Optimum beam ratio appears to be 16 to 1 (contact to pivot distance vs. pivot to link distance)

7. Optimum differential pressure at room temperature ranges from .5 to .8 psid to maintain the bandwidth, at temperature extremes, to within the 2 psid bandwidth.

8. Electrical breakdown across the .004" air gap occurs at 300 vac rms with a backfill pressure less than 100 mbs.

9. Nitrogen gas was used for backfill in the cover chamber and the use of helium gas will lower the voltage at which breakdown occurs across the contact air gap.

10. Mechanical linkage can withstand the fatiguing stresses during contact cycling

11. External adjustment can be made to change the operating point.

12. Contact transfer time of less than 5 msec was achieved.

13. Circuit resistance of less than .5 ohms was achieved.

14. Snap-action can be improved by reducing the plating thickness which will improve the vibration capabilities.

RECOMMENDATIONS:

1. Increase the thickness of the ceramic insulator located between the bottom magnet and the bellows cap so that a higher breakdown voltage can be achieved.

2. Investigate the cause of calibration diaphragm failure, and initiate corrective action.

3. Improve the natural frequency of the beam and pivot assembly through the weight reduction of the beam and counterbalance.

4. Redesign cover assembly to provide a recessed area for protection of the backfill tube.

IV. APPENDIX

A. TEST DATA

1. 23 PSIA SWITCH
2. 30 PSIA SWITCH
3. 45 PSIA SWITCH
4. SUPPLEMENTAL TESTS

TEST: PRELIMINARY PROCESSING & TESTING DATE: 6/9/66

PERFORMED BY: R. DAVIS/C. LAMBERT

SWITCH ASSY: 23 PSIA VOLTAGE: 6V CURRENT: 40 MA

SYSTEM PORT ☐ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: ATMOSPHERIC PRESSURE:

SWITCH:

1. ULTRASONICALLY CLEAN SWITCH PRIOR TO WELDING 6/8
2. CHECK ACTUATION DEACTUATION PRIOR TO TACK WELDING COVER, TWO PLACES 6/9

#1	#2	ΔP
33.35 PSI	33.75 PSI	.4 PSID

3. AFTER TACK WELDING

33.30	33.75	.45
33.30 (TEMP. CYCLE)	33.75	.45

4. HELI-ARC COVER TO HOUSING (CURRENT 80 AMPS)

33.35	33.80	.45	(UNIT STILL WARM)

5. CLEAN SWITCH & CHECK ACT.-DEACT. PRESS. @ ROOM TEMP. 6/1[illegible]

33.30	33.70	.4

6. LEAK CHECK COVER CHAMBER (CONNECTOR, WELD, DIFFERENTIAL SCREW, AND SYSTEM PORT.)

   NO LEAKAGE (10^{-9} ATMOSPHERE HELIUM/CM^3/SEC)
7. OUTGAS COVER CHAMBER
   a. 190°F, 2.5 HRS, VACUUM 7-8 MICRONS OF Hg
   b. GRADUAL RETURN TO ROOM TEMP. WITH VACUUM ON BACKFILL TUBE
8. BACKFILL WITH PURIFIED NITROGEN (278 MBS)
   TEMP. OF GREY ROOM 72°F

9. CHECK ACT.-DEACT. PRESS. @ ROOM TEMP.

#1	#2	ΔP
23.00 PSIA	23.48 PSIA	.48 PSID
23.00	23.48	.48
23.00	23.48	.48
23.00	23.48	.48

81.5°F 6/13 14.6psi

10. PRESSURIZE SWITCH THRU SYSTEM PORT @ 120 psig 20 CYCLES. LAST 4 CYCLES HOLD PRESSURE FOR 5 MIN.

	#2 (HEISE GAGE)	
(23 psia)	8.4 psig	1 CYCLE @ 120 psig
(23.4)	8.8	2 CYCLES @ 120 psig

TEST: PRELIMINARY PROCESSING AND TESTING **DATE:** 6/13/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 23 psia **VOLTAGE:** 6V **CURRENT:** 40 Ma

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: ______ **ATMOSPHERIC PRESSURE:** ______

SWITCH: ______

10. a. PRESSURE CYCLE @ 120 psig (CONTINUED)

	#2	
(23.4) psia	8.8 psig	3 CYCLES @ 120 psig
(23.3)	8.7	4 "
(23.5)	8.9	10 "
(23.6)	9.0	16 "
(23.5)	8.9	17 CYCLES @ 120 psig 5 MIN
(23.5)	8.9	18 "
(23.4)	8.8	19 "
(23.4)	8.8	20 "

b. CHECK ACTUATION – DEACTUATION PRESSURE $\boxed{81°F}$ 6/14 999 MB

#1	#2	ΔP
23.05 psia	23.50 psia	.45 psid
23.05	23.50	.45
23.05	23.50	.45

c. SUBMERGE UNIT IN LIQUID NITROGEN $\boxed{-320°F}$

	21.75	22.45	.70
5 MIN.	21.75	22.45	.70
	21.75	22.45	.70
10 MIN	21.75	22.50	.75
	21.75	22.50	.75
15 MIN	21.78	22.55	.77
	21.78	22.55	.77
	21.78	22.55	.77
	21.75	22.58	.83
20 MIN	21.75	22.58	.83
	21.75	22.55	.80

d. DETERMINE ACT. – DEACT. AT ELEVATED TEMP. $\boxed{+165°F}$

23.35	23.85	.50
23.40	23.80	.40
23.40	23.80	.40

TEST: PRELIMINARY PROCESSING & TESTING **DATE:** 6/15/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 23 PSIA **VOLTAGE:** 6V. **CURRENT:** 40 Ma

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: ______ **ATMOSPHERIC PRESSURE:** ______

SWITCH: ______

1002 MB

*

11. BACKFILL 186.5 MB PURIFIED NITROGEN

#1	#2	ΔP	
21.42 psia	21.88 psia	.46 psid	78°F
21.42	21.88	.46	
21.42	21.88	.46	

RESET DIFFERENTIAL SCREW 78°F

22.63	23.05	.42	
22.63	23.05	.42	
22.65	23.05	.40	

CHECK ACT.- DEACT. PRESSURE WITH UNIT SUBMERGE IN LN

10 MIN.	22.60	23.05	.45	-320°F
	22.60	23.05	.45	
15 MIN	22.62	23.08	.46	
	22.62	23.08	.46	
	22.62	23.08	.46	
	22.62	23.08	.46	
	22.62	23.08	.46	
20 MIN	22.62	23.08	.46	
	22.62	23.08	.46	

ACTUATION - DEACTUATION WITH UNIT @ +165°F

23.04 SEVERAL OVER PRESS. CYCLES

22.79	23.18	.39
22.79	23.17	.38
22.79	23.17	.38

ACTUATION - DEACT. WITH UNIT @ 78°F

22.61	22.98	.37
22.61	22.98	.37
22.61	22.98	.37

6/16
80°F
998 MB

12. SYSTEM PORT CHECK 80°F

22.65	23.02	.37
22.65	23.02	.37

CALIBRATION PORT ACTUATION- DEACTUATION 80°F

23.60	23.92	.32
23.59	23.91	.32
23.59	23.90	.31
23.59	23.90	.31

NO LEAKAGE @ 24 PSIA WITH SYSTEM PORT OPEN (10 MINUTES)

TEST: PRELIMINARY PROCESSING AND TESTING **DATE:** 6/16/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 23 PSIA **VOLTAGE:** 6V **CURRENT:** 40ma

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: ______ **ATMOSPHERIC PRESSURE:** ______

SWITCH: ______

13. SYSTEM PORT RE-CHECK

#1	#2	ΔP
22.68 psia	23.03 psia	.35 psid
22.68	23.03	.35
22.68	23.03	.35

6/17/66

50 psia PRESS. ON SYSTEM PORT NO LEAKAGE DETECTED IN 10 MINUTES WITH UNIT SUBMERGED IN TRICHLOROETH-ELENE

TEST: EVALUATION TESTS DATE: 6/20/66

PERFORMED BY: R. DAVIS

SWITCH ASSY: 23 PSIA VOLTAGE: — CURRENT: —

SYSTEM PORT ☐ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 80°F ATMOSPHERIC PRESSURE: 1008.4

SWITCH:

DIELECTRIC STRENGTH

ACT. - DEACT.

#1	#2
22.64 PSIA	23.09 PSIA
22.64	23.09
22.64	23.09

#1	CONTACT PIN (A) TO	SWITCH	BODY	750 VAC
#2	" (B) "	"	"	650 VAC
#1	" (A) "	COMMON	CONTACT	400 VAC
#2	" (B) "	"	"	300 VAC

ACT. - DEACT.

#1	#2
22.64 PSIA	23.09 PSIA
22.64	23.09
22.64	23.09

PIN (C) COMMON CONTACT TO SWITCH BODY → 675 VAC

6/21

CIRCUIT RESISTANCE

#1 ACT. - DEACT.	#2
22.65	23.11
22.65	23.11

28VDC 100 Ma.	.20	28VDC 150 Ma.	9.5
200 Ma.	.20	150 Ma.	2.0
300 Ma.	.20		

INSULATION RESISTANCE 500 VDC

#1	#2
23.11	22.65
23.11	22.65

PIN	C	TO	CASE	3000	MEGOHMS
	A	TO	CASE	5000	"
	B	TO	CASE	10,000	"
	A	TO	C	INFINITY	
	B	TO	C	"	

TEST: PROOF PRESSURE (4.3.3.2) DATE: 6/23/66

PERFORMED BY: DAVIS

SWITCH ASSY: 23 PSIA VOLTAGE: 30 VDC CURRENT: 50 Ma.

SYSTEM PORT ☑ CALIBRATION PORT ☑

TEMPERATURE, AMBIENT: 80°F ATMOSPHERIC PRESSURE: 1002.0 MB 14.6 PSI

SWITCH: 80°F

SYSTEM PORT

#1	#2
7.90 PSIG	8.20 PSIG
(22.50 PSIA)	(22.8)

CALIBRATION PORT

#1	#2
8.10 PSIG	9.30 PSIG
(22.7)	(23.9)

TEST: SETTINGS (ACTUATION - DEACTUATION PRESS.) CIRCUIT RESISTANCE DATE: 6/23/66

PERFORMED BY: R. DAVIS / J. STURLA

SWITCH ASSY: 23 PSIA VOLTAGE: 30 VDC CURRENT: 50 MA

SYSTEM PORT ☑ CALIBRATION PORT ☑

TEMPERATURE, AMBIENT: 80°F ATMOSPHERIC PRESSURE: 1007 MB

SWITCH: —

SYSTEM PORT

	Contact #1	Voltage Drop		Contact #2	Voltage Drop	
ROOM TEMP.	22.55 PSIA	.005 V	.1Ω	23.05 PSIA	.005 V	.1Ω
	22.55	.005	ΔP=.5	23.05	.005	
	22.55	.005		23.05	.005	
-320°F	22.32	.010	.2Ω	23.22	.009	.18Ω
	22.32	.010	ΔP=.9	23.22	.010	
	22.32	.010		23.22	.011	
+165°F	22.78	.005	.1Ω	23.25	.006	.12Ω
	22.79	.005	ΔP=.46	23.25	.006	
	22.79	.006		23.25	.006	

ΔP= .93 psid

CALIBRATION PORT

	Contact #1	Voltage Drop		Contact #2	Voltage Drop	
ROOM TEMP.	22.60 PSIA	.005 V	.1Ω	23.08 PSIA	.015 V	.3Ω
	22.60	.005	ΔP=.48	23.08	.012	
	22.60	.005		23.08	.011	
-320°F	22.30	.006	.12Ω	23.18	.009	.18Ω
	22.30	.006	ΔP=.88	23.18	.009	
	22.30	.006		23.18	.009	
+165°F	22.78	.005	.1Ω	23.27	.005	.1Ω
	22.78	.005	ΔP=.49	23.27	.005	
	22.79	.005		23.27	.005	

ΔP= .97

TEST: TEMPERATURE SHOCK (+165°F TO -320°F) DATE: 6-24-66

PERFORMED BY: R. DAVIS / J. STURLA

SWITCH ASSY: #23 PSIA. VOLTAGE: 28VDC. CURRENT: 3 AMP.

SYSTEM PORT [✓] CALIBRATION PORT [ ]

TEMPERATURE, AMBIENT: 80°F ATMOSPHERIC PRESSURE: 1003.5 MB.

SWITCH: —

TEMP SHOCK 80°F	CONTACT #1	VOLTAGE DROP		CONTACT #2	VOLTAGE DROP	
	22.58	.26	.087 Ω	23.12	.51	.17 Ω
	22.58	.26	Δ P = .54	23.12	.46	.15 Ω
	22.58	.26		23.12	.36	.12 Ω
1 cycle +165°F TO -320°F				23.12	.52	.17 Ω
READ @ +170°F	22.78 •	.27	.09 Ω	23.65 •	.28	.093 Ω
	22.78	.27	Δ P. = .72	23.50	.23	.077 Ω
UNIT INTO -320°F	23.38 •	.26		$\boxed{23.90}$ •	.30	
3 MIN.	23.40	.26	.087 Ω	23.89	.28	.093 Ω
	23.38	.26	Δ P = .51	23.89	.27	.09 Ω
	23.20	.26		23.89	.27	
4 MIN.	23.20	.26	Δ P. .58	23.78	.26	.087 Ω
	23.20	.25	.083 Ω	23.72	.27	
10 MIN.	23.23	.25	Δ P. = .57	23.80	.26	
14 MIN.	22.50	.24	.08 Ω	23.40	.26	
	22.50	.24	Δ P. = .9	23.40	.26	
17 MIN.	22.50	.24		23.40	.26	
22 MIN.	22.48	.24	Δ P. = .9	23.38	.26	
	22.48	.24		23.40	.26	
25 MIN.	22.48	.24	Δ P. = .9	23.38	.26	
30 MIN.	22.48	.25		23.38	.27	.09 Ω
	22.48 •	.25		23.40 •	.26	
	22.48	.24	Δ P. = .9	23.38	.26	

TEST: TEMPERATURE TEST DATE: 6-27-66

PERFORMED BY: R. DAVIS / J. STURLA

SWITCH ASSY: # 23 PSIA. VOLTAGE: 22 VDC. CURRENT: 2.2 AMPS.

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 90 °F ATMOSPHERIC PRESSURE: 1000

SWITCH: —

TEMP. TEST 90 °F	CONTACT #1	VOLTAGE DROP		CONTACT #2	VOLTAGE DROP	
22 VDC.	22.44	.23	.10 Ω	23.11	.24	.11 Ω
2.2 AMPS.	22.45	.23	Δ P. = .65	23.10	.23	
	22.45	.22	.1 Ω	23.10	.23	
-320 °F						
5 HRS.	3.2 AMPS.			30 VDC.		
	22.21	.34	.11 Ω	23.21	.33	.10 Ω
	22.19	.33	.10 Ω	23.21	.34	.11 Ω
	22.20	.33	Δ P. = 1.02	23.22	.34	
+165 °F						
45 MIN.	22.65	.36	.113 Ω	23.31	.34	
	22.67	.35	.11 Ω	23.30	.34	.11 Ω
	22.67	.35	Δ P. = .93	23.30	.34	

6/28/66

24 HRS @ +165 °F 3.2 AMPS 29.5 VDC.

	22.49	.35	.11 Ω	23.11	.36	.113 Ω
	22.49	.35	Δ P. = .61	23.10	.35	.11 Ω
	22.49	.35		23.10	.35	

TEST: VIBRATION – SINUSOIDAL **DATE:** 6/30/66

PERFORMED BY: R. DAVIS / C. WOOD / E

SWITCH ASSY: 23 PSIA **VOLTAGE:** **CURRENT:**

SYSTEM PORT ☑ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 75°F **ATMOSPHERIC PRESSURE:**

SWITCH:

GALVANOMETERS 0 - 3000 CPS TAPE SPEED = .25"/SEC

SCAN 5 → 2000 CPS 5-38 CPS @ .4 D.A.

II @ 30 G PEAK 38-2000 CPS @ 30 G PEAK TO PEAK

#2 CONTACT NOT FUNCTIONING, NOT OPERATING RELAY CONTACTS, CONTIN. CHECK

	#1	#2	ΔP
	22.40	22.95	.55
	22.40	22.95	.55
	22.40	22.95	.55
.5 PSI HOLD			
40 CPS	21.90		
700-900 CPS	21.80	CHATTER	
1360-2000 CPS	21.60	CHATTER	
0 CPS	22.55	22.92	

IIA 1 PSI HOLD 21.60

SCAN 700-1500 CPS @ 30G

700

1300 CHATTER

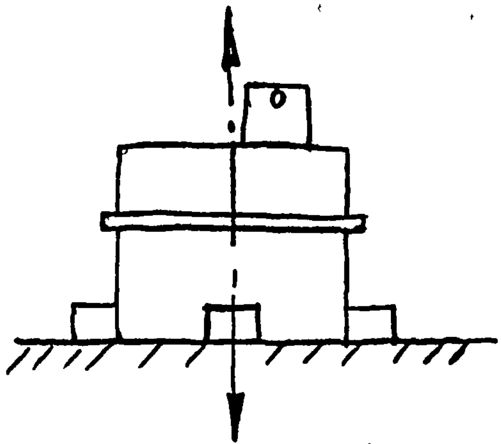
1500

SCAN 700-1500 CPS @ 30G

700 21.40

~850 CHATTER

1500



DIRECTION OF VIBRATION (VERTICAL)

IIB MANUAL-SCAN

1.5 psi HOLD 21.00 1270-1280

SCAN 700-1500 CPS @ 30G CHATTER @ 1270 CPS 700-900 CPS NO CHATTER

IIC 2 PSI HOLD 20.50

SCAN 700-1500 CPS @ 30G CHATTER @ 1270 CPS

IID 2.5 PSI HOLD 20.00

SCAN 1000-1500 CPS @ 30G CHATTER @ 1270 CPS

IIE SCAN 700-1500 CPS @ 20G's

w/ .5 PSI HOLD 22.58 } 0 CPS 22.95 CHATTER @ 1270 CPS

22.58 22.95

SCAN 700-1500 CPS @ 5G's NO CHATTER

w/ .5 PSI HOLD

TEST: VIBRATION – SINUSOIDAL DATE: 6/30/66

PERFORMED BY: R. DAVIS / C. WOOD / E

SWITCH ASSY: 23 psia VOLTAGE: ______ CURRENT: ______

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 75°F ATMOSPHERIC PRESSURE: ______

SWITCH: ______

IIE

SCAN 700-1500 CPS @ 12 G's w/.5 psi HOLD — CHATTER @ 1270 CPS

NO OSCILL. RECORD

SCAN 700-1500 CPS @ 10 G's w/.5 psi HOLD — CHATTER DROP-OUT @ 1270 CPS

RESONANCE SEARCH

IIF

	#1	#2
	22.55 psia	22.95 psia
	22.55	22.95
1 G's 500 - 5000 CPS	22.55	22.95

MAKE POINT @ 22.50

NO CHATTER

IIG

5 G's

500 - 5000 CPS

CHATTER @ 4800 CPS

II H

10 G's

500 - 5000 CPS

CHATTER @ 2250 CPS

CHATTER @ 4700 CPS

22.62 22.95

TEST: VIBRATION — SINUSOIDAL DATE: 6/30/66

PERFORMED BY: R. DAVIS / C. WOOD / E

SWITCH ASSY: 23 PSIA VOLTAGE: ______ CURRENT: ______

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 75°F ATMOSPHERIC PRESSURE: ______

SWITCH: ______

II i

RE-RUN

10G's

100 - 5000 CPS W/ MAKE POINT @ 22.57 psia

CHATTER @ 1280 CPS
2200 - 2750 CPS
3000 CPS
3300 - 4250 CPS
4300 - 5000 CPS

#1	#2
22.62	22.95
22.62	22.95

TEST: TEMP. TEST (ROOM TEMP TO L. HELIUM) **DATE:** 6/30/66

PERFORMED BY: SPOONER/DAVIS/STURLA/LAMBERT

SWITCH ASSY: 23 psia **VOLTAGE:** 28 VDC **CURRENT:** 3 AMPS

SYSTEM PORT ☑ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 90 °F **ATMOSPHERIC PRESSURE:** 1005.1 MB

SWITCH:

1. ACTUATION–DEACTUATION READINGS WERE TAKEN @
   a. ROOM TEMP.
   b. L N TEMP.
   c. L He TEMP.

ROOM TEMP (90°F)

#1	VOLTAGE DROP		ΔP	#2	VOLTAGE DROP	
22.61 psia	.30	.1Ω	.37 psid	22.98 psia	.30	.1Ω
22.60	.28	.09Ω	.38	22.98	.33	.11Ω
22.60			.38	22.98		
22.60				22.98		

−320°F

	#1	ΔP	#2
	22.75	.43	23.18
	21.78	.40	22.18
	21.68	.32	22.00
	21.72	.32	22.04
	21.75	.29	22.04
	21.75	.29	22.04
	21.85	.55	22.40
	21.85	.60	22.45
	21.88	.62	22.40
	21.96	.39	22.35
	21.98	.37	22.35
	22.01	.34	22.35
	22.01	.39	22.40
10 MIN	22.01	.39	22.40

LIQUID HELIUM
−452°F

	#1	ΔP	#2
	21.50	.70	22.20
2 MIN	21.60	.70	22.30
	21.80	.60	22.40
4 MIN	21.80	.55	22.35
	21.50	.65	22.15
	21.55	.55	22.10
	21.60	.50	22.10
	21.80	.45	22.25
	22.00	.50	22.50

TEST: TEMP. TEST (ROOM TEMP. TO L. HELIUM) DATE: 6/30/66

PERFORMED BY: SPOONER/DAVIS/STURLA/LAMBERT

SWITCH ASSY: 23 psia VOLTAGE: 28 VDC CURRENT: 3 AMPS

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 90 °F ATMOSPHERIC PRESSURE: 1005.1 MB

SWITCH: __________

CONTINUED

-452°F	#1	ΔP	#2
	22.00 psia	.50 psid	22.50 psia
	22.00	.50	22.50
	22.00	.50	22.50
ADD LHe	22.00	.50	22.50
	22.00	.50	22.50
	22.00	.50	22.50
	22.00	.50	22.50
	22.00	.50	22.50
8 MIN.	22.00		—
	22.20	.55	22.75
	22.20	.65	22.85
	22.15	.65	22.80
	22.15	.55	22.70
	22.15	.53	22.68
	22.15	.53	22.68
	22.10	.50	22.60
	22.15	.45	22.60
11 MIN.	22.15	.45	22.60
ADD LHe	21.70	.80	22.50
	21.60	.65	22.25
	21.65	.7	22.35
	21.75	.6	22.35
	21.75	.55	22.30
	21.75	.55	22.30
	21.75	.55	22.30
	21.75	.5	22.25
	21.70	—	—
ADD LHe 16 MIN	21.60	.65	22.25
	21.65	.60	22.25
	21.70	.58	22.28
	21.65	.60	22.25
	21.65	.55	22.20
	21.65	.55	22.20
	21.65	.55	22.20
	21.65	.55	22.20
	21.95	.67	22.62
	22.15	—	—

TEST: TEMP. TEST (ROOM TEMP. TO L. HELIUM) DATE: 6/30/66

PERFORMED BY: Spooner/DAVIS/STURIA/LAMBERT

SWITCH ASSY: 23 psia VOLTAGE: 28 VDC CURRENT: 3 AMPS

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 90°F ATMOSPHERIC PRESSURE: 1005.7 MB

SWITCH: __________

(CONTINUED)

-452°F

	#1	ΔP	#2
ADD LHe	21.75	.55	22.30
	21.90	.60	22.50
	21.90	.60	22.50
	21.95	.67	22.62
	22.00	.62	22.62
	22.00	.62	22.62
	22.03	.62	22.65
	22.02	.63	22.65
26 MIN	22.02	.63	22.65

TEST: LIFE CYCLE DATE: 7/6/66

PERFORMED BY: R DAVIS

SWITCH ASSY: # 23 VOLTAGE: CURRENT:

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: ATMOSPHERIC PRESSURE:

SWITCH:

90°F 6VDC 40 ma.

#1		#2		
22.32		22.82	ΔP .50	
.32		.82	.50	
.32		82	.50	

31VDC 3.5 AMP

	VOLTAGE DROP			VOLTAGE DROP
22.10	.37	22.98	ΔP .88	.75
.48	.38	.98	.50	.74
.48	.37	.98	.50	.74

15 CYCLES 90°F

22.45	.37	22.98	ΔP .48	.53
.45	.37	.98	.48	.53
.45	.37	.98	.48	.53

1,165 CYCLES 29 VDC 3.1 AMP TOTAL 1,180

.37	.37
.37	.37
.37	.37

90°F 3.1 VDC 3.3 AMP. 7/7/66

.37	.37
.37	.37
.37	.37

3,000 CYCLES 30.5 VDC 3.2 AMP TOTAL 4,180

270 CYCLES 28VDC 3AMP TOTAL 4,450

22.32	.32	23.0	ΔP .68	.32
.32	.32	.0	.68	.32
.32	.32	.0	.68	.32

\- 880 CYCLES 26VDC 2.8 AMP ← 320°F TOTAL 5,330

ROOM RETURN 90°F

22.25	22.93	ΔP .68
.25	.93	.68
.25	.93	.68

TEST: PRELIMINARY PROCESSING & TESTING DATE: 6/9/66

PERFORMED BY: R. DAVIS/C. LAMBERT

SWITCH ASSY: 30 PSIA VOLTAGE: — CURRENT: —

SYSTEM PORT ☐ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: ATMOSPHERIC PRESSURE:

SWITCH:

1. ULTRASONICALLY CLEAN SWITCH PRIOR TO WELDING 6/8
2. CHECK ACTUATION-DEACTUATION PRESSURE PRIOR TO ATTACHING WIRES TO COVER 6/9

#1	#2	ΔP
39.70 PSI	40.24 PSI	.54 PSID

3. SOLDER WIRES AND PLACE COVER ON UNIT & TEMP. CYCLE

39.65	40.20	.55

4. HELI-ARC COVER TO HOUSING (CURRENT 86 AMPS)

39.72	40.24	.52 (UNIT STILL WARM)

5. CLEAN SWITCH & CHECK ACT.-DEACT. PRESS. @ ROOM TEMP. 6/10

39.85	40.42	.57

6. LEAK CHECK COVER CHAMBER (CONNECTOR, WELD, DIFFERENTIAL SCREW, AND SYSTEM PORT)
   NO LEAKAGE (10^{-9} ATM. He/cm^3/SEC
7. OUTGAS COVER CHAMBER
   a. 190°F, 2.5 HRS. VACUUM 7-8 MICRONS OF Hg
   b. GRADUAL RETURN TO ROOM TEMP. WITH VACUUM ON BACKFILL TUBE.
8. BACKFILL WITH PURIFIED NITROGEN (278 MBS)
   TEMP. OF GREY ROOM 72°F
9. CHECK ACT.-DEACT. PRESS. @ ROOM TEMP.

#1	#2	ΔP
29.52 PSIA	30.03 PSIA	.51 PSID
29.52	30.03	.51
29.52	30.03	.51

10. PRESSURIZE SWITCH THRU SYSTEM PORT @ 120 psig 20 CYCLES (Maximum 81.5°F 6/13/66)
    LAST 4 CYCLES HOLD 120 psig PRESSURE FOR 5 MIN.

	#2 (HEISE GAGE)	
(30.3 PSIA)	15.7 psig	
(30.0)	15.4	1 CYCLE @ 121 PSIG
(30.1)	15.5	5 CYCLES @ 121 PSIG

TEST: PROTOTYPE PROCESSING & TESTING **DATE:** 6/13/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 30 PSIA **VOLTAGE:** 6 V **CURRENT:** 40 Ma

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: ______ **ATMOSPHERIC PRESSURE:** ______

SWITCH: ______

10.a. PRESSURE CYCLE @ 120 psig (CONTINUED)

	#2		
(30.1 PSIA)	15.5 psig	10 CYCLES @ 121 psig	
(30.1)	15.5	15 "	
(30.1)	15.5	17 CYCLES @ 121 PSIG	5 MIN.
(30.1)	15.5	18 "	
(30.0)	15.4	19 "	
(30.0)	15.4	20 "	

SMALL LEAK IN CAL. SHELL

6/15
1002 MB

b. CHECK ACTUATION–DEACT. PRESS. 78°F

#1	#2	ΔP
28.88 psia	29.51 psia	.63 psid
28.88	29.48	.60
28.88	29.48	.60
28.88	29.48	.60

c. SUBMERGE UNIT IN LIQUID NITROGEN −320°F

	27.38 psia	28.51 psia	1.13
10 MIN.	27.35	28.51	1.16
	27.32	28.51	1.19
	27.32	28.51	1.19
20 MIN	27.32	28.50	1.18
	27.30	28.50	1.20
	27.30	28.50	1.20
	27.30	28.50	1.20

d. DETERMINE ACTUATION–DEACT. @ ELEV. TEMP. +165°F

29.22	29.78	.56
29.22	29.78	.56
29.22	29.78	.56

e. ROOM RETURN 78°F

28.94	29.50	.56
28.94	29.50	.56
28.94	29.50	.56

TEST: PROTOTYPE PROCESSING & TESTING **DATE:** 6/15/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 30 psia **VOLTAGE:** 6 V. **CURRENT:** 40 Ma

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: ______ **ATMOSPHERIC PRESSURE:** ______

SWITCH: ______

11. BACKFILL 186.5 MB PURIFIED NITROGEN 1001 MB 82°F

	#1	#2	ΔP	
	27.56 psia	28.19 psia	.63 psid	82°F
	27.57	28.19	.62	
	27.57	28.19	.62	

RESET DIFFERENTIAL SCREW

	29.48	30.03	.55	82°F
	29.48	30.03	.55	
	29.48	30.03	.55	

CHECK ACT.-DEACT. PRESS. WITH UNIT SUBMERGED IN LN

	29.28	30.32	1.04	-320°F
10 MIN	29.28	30.32	1.04	
	29.28	30.32	1.04	
	29.28	30.32	1.04	
15 MIN	29.28	30.32	1.04	
	29.28	30.32	1.04	

ACTUATION - DEACT. WITH UNIT @ +165°F

29.41	29.92	.51
29.42	29.92	.50
29.42	29.92	.50
29.42	29.92	.50

12.* BACKFILL CHANGED TO 213 MB 6/16 998 MB 80°F

29.68	30.22	.54	80°F
29.68	30.22	.54	

RESET DIFFERENTIAL SCREW

29.45	30.00	.55	80°F
29.46	30.00	.54	
29.46	30.00	.54	

CHECK ACT.-DEACT. WITH UNIT SUBMERGED IN LN

	28.95	30.02	1.07	-320°F
15 MIN	28.95	30.02	1.07	
	28.95	30.02	1.07	

TEST: PROTOTYPE PROCESSING & TESTING **DATE:** 6/16/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 30 PSIA **VOLTAGE:** 6V **CURRENT:** 40 Ma

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: ______ **ATMOSPHERIC PRESSURE:** ______

SWITCH: ______

12. CONTINUED. $\boxed{-320°F}$

	#1	#2	ΔP
	28.95 psia	30.02 psia	1.07 psid
25 MIN	28.95	30.02	1.07
	28.95	30.02	1.07
	28.95	30.02	1.07
30 MIN	28.95	30.02	1.07
	28.95	30.02	1.07

ACTUATION-DEACT. WITH UNIT @ $\boxed{+165°F}$

	29.55	30.08	.53
1 HR	29.55	30.08	.53
	29.55	30.08	.53
	29.55	30.08	.53

ACTUATION - DEACT. WITH UNIT @ $\boxed{80°F}$

29.44	30.01	.57
29.44	30.01	.57
29.44	30.01	.57
29.44	30.01	.57

13. CALIBRATION PORT ACTUATION—DEACTUATION $\boxed{80°F}$

#1	#2	
30.06	30.58	.52
30.06	30.58	.52
30.06	30.58	.52

LEAK RATE IN CALIB SHELL ≈ .1 psi/5 MIN. (SYSTEM PORT OPEN)

14. SYSTEM PORT RE-CHECK

29.45	30.01	.56
29.45	30.01	.56
29.45	30.01	.56

6/17/66

50 psia PRESS APPLIED TO SYSTEM PORT. LEAKAGE APPROX. .1 psi/5 MIN. WITH UNIT SUBMERGED IN TRICHLOROETHELENE

TEST: EVALUATION TESTS DATE: 6/20/66

PERFORMED BY: R. DAVIS

SWITCH ASSY: 30 psia VOLTAGE: ——— CURRENT: ———

SYSTEM PORT ☐ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 80°F ATMOSPHERIC PRESSURE: 1008.4

SWITCH:

DIELECTRIC STRENGTH

#1	#2
29.42	30.00
29.43	30.00
29.43	30.00

#1 CONTACT PIN (A) TO SWITCH BODY 725 VAC
#2 " (B) " " " 550 VAC

#1 " (A) TO COMMON CONTACT 400 VAC
#2 " (B) " " " 310 VAC

#1	#2
29.39	29.94
29.39	29.94
29.39	29.94

PIN (C) COMMON CONTACT TO SWITCH BODY 625 VAC 6/21

CIRCUIT RESISTANCE

		#1	#2
		29.38	29.92
		29.38	29.22
28 VDC	Ma. 100	.29	.22
	Ma. 200	.29	.22
	Ma. 300	.29	.22

INSULATION RESISTANCE 500 VAC

#1	#2
29.38	29.98
29.38	29.98

PIN	C	TO	CASE	INFINITY
	A	TO	CASE	"
	B	TO	CASE	"
	A	TO	C	"
	B	TO	C	"

TEST: PROOF PRESSURE (4.3.3.2) DATE: 6/23/66

PERFORMED BY: DAVIS

SWITCH ASSY: 30 psia VOLTAGE: 28 VDC CURRENT: 50 Ma

SYSTEM PORT ☐ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 80°F ATMOSPHERIC PRESSURE: 1007.0
14.6 psi

SWITCH: # -

SYSTEM PORT

#1	#2
14.90 PSIG	15.40 PSIG
(29.5)	(30.0)

CALIBRATION PORT

#1	#2
15.50 PSIG	16.0 PSIG
(30.1)	(30.6)

TEST: SETTINGS (ACT. - DEACT. PRESS.) CIRCUIT RESISTANCE **DATE:** 6/23/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 30 PSIA **VOLTAGE:** 30 VDC **CURRENT:** 50 Ma

SYSTEM PORT ☑ **CALIBRATION PORT** ☑

TEMPERATURE, AMBIENT: 80°F **ATMOSPHERIC PRESSURE:** 1007 MB

SWITCH: —

SYSTEM PORT

	CONTACT #1	VOLTAGE DROP		CONTACT #2	VOLTAGE DROP	
ROOM TEMP	29.22 PSIA	.0065 V	.13 Ω	29.89	.02 V	.4 Ω
	29.22	.007	ΔP=.67	29.88	.025	
	29.22	.007		29.88	—	
−320°F	• 28.60	.007	.14 Ω	29.80	—	
	28.61	.007	ΔP=1.2	29.80	—	
	28.61	.007		29.80	—	
+165°F	29.22	.007	.14 Ω	29.90 •	.040	→ .034
	29.22	.006	ΔP=.67	29.89	.020	
• ΔP=1.3 PSID	29.22	.006		29.89	.018	

CALIBRATION PORT

ROOM TEMP.	29.58	.006	.12 Ω	30.19	.064	
	29.59	.006	ΔP=.6	30.19	.052	
	29.61	.006		30.19	.050	
−320°F	• 29.08	.008	.16 Ω	30.15	—	
	29.08	.007	ΔP=1.0	30.08	—	
	29.08	.007		30.08	—	
+165°F	29.66	.006	.12 Ω	30.22	.013	.26 Ω
	29.66	.006	ΔP=.56	30.22	.018	
• ΔP=1.14 PSID	29.66	.006		30.22 •	.018	

SYSTEM PORT

28 VDC 3 AMPS 1004

ROOM TEMP.	• 29.22	.37	.12 Ω	29.90 •	.33	.11 Ω
	29.22	.37	ΔP=.68	29.90	.31	
	29.22	.37		29.90	.29	
	12 ADDITIONAL CYCLES					
ΔP = .68	29.22		ΔP=.68	29.90	.28	

CALIBRATION PORT

28 VDC 3 AMPS

ROOM TEMP.	• 29.56	.36	.12 Ω	30.20 •	.30	.10 Ω
	29.56	.34	ΔP=.64	30.20	.30	
ΔP=.64	29.56	.32		30.20	.28	

CHECK @ 28VDC 50Ma .005 .1 Ω .005 .1 Ω

TEST: TEMPERATURE TEST
CIRCUIT RESISTANCE

DATE: 6-24-66

PERFORMED BY: R. DAVIS / J. STURLA

SWITCH ASSY: 30 PSIA. **VOLTAGE:** 28 VDC. **CURRENT:** 3 AMP.

SYSTEM PORT ☑ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 80°F **ATMOSPHERIC PRESSURE:** 1003.5 MB.

SWITCH: —

SYSTEM PORT ROOM TEMP.	CONTACT #1	VOLTAGE DROP		CONTACT #2	VOLTAGE DROP	
	29.08 PSIA.	.28 V.	.093Ω	29.82 PSIA.	.28 V.	.093Ω
	29.09	.28	ΔP = .73	29.82	.28	
	29.12	.29	.097 Ω	29.83	.28	
−320°F 10 MIN.	28.50	.26	.087 Ω	29.91	.26	.087Ω
	28.50	.26	ΔP = 1.58	30.08	.26	
	28.50	.24	.08 Ω	29.91	.25	.083Ω
	28.50	.24		29.90	.24	
−320°F 30 MIN.	28.50	.24	.08Ω	29.87	.24	.08Ω
	28.50	.24	ΔP = 1.37	29.87	.24	
	28.50	.24		29.87	.24	
−320°F 7 HRS. @ −320°F	2.2 AMPS.		22 VDC.			
	28.50	.31	.15Ω	29.88	.32	.15Ω
	28.50	.32	ΔP = 1.47	29.87	.32	
	28.50	.32		29.86	.32	

FOR +165°F SEE PAGE 6
24 HR SOAK

TEST: TEMPERATURE TEST DATE: 6-24-66

PERFORMED BY: R. DAVIS / J. STURLA

SWITCH ASSY: # 30 PSIA. VOLTAGE: 28 VDC. CURRENT: 3 AMP.

SYSTEM PORT [ ] CALIBRATION PORT [✓]

TEMPERATURE, AMBIENT: 80 °F ATMOSPHERIC PRESSURE: 1003.5 MB.

SWITCH: —

CALIBRATION PORT

	CONTACT #1	VOLTAGE DROP		CONTACT #2	VOLTAGE DROP	
ROOM TEMP.	29.58 PSIA.	.29 V	.097 Ω	30.20 PSIA.	.28 V.	.093 Ω
	29.58	.29	ΔP. = .62	30.20	.28	
	29.58	.29		30.20	.28	
−320 °F 10 MIN.	29.17	.26	.087 Ω	30.32 •	.26	
	29.14 •	.24	ΔP. = 1.15	30.29	.25	.083 Ω
	29.16	.24		30.30	.24	.08 Ω
−320 °F 25 MIN.	29.0	.24	.08 Ω	30.15	.26	.087 Ω
	29.0	.24		30.18	.25	.083 Ω
	29.0	.24	Δ P. = 1.15	30.15	.24	
				30.15	.24	
−320 °F 7 HRS. @ −320 °F	2.2 AMPS.		22 VDC.			
	28.90	.32	.15 Ω	30.18	.32	.15 Ω
	28.89 •	.32	ΔP. =	30.18 •	.32	
	28.91	.32		30.18	.32	

TEST: TEMPERATURE SHOCK & TEMP. TEST **DATE:** 6-27-66

PERFORMED BY: R. DAVIS / J. STURLA

SWITCH ASSY: #30 PSIA. **VOLTAGE:** — **CURRENT:** —

SYSTEM PORT ☑ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 88 °F **ATMOSPHERIC PRESSURE:**

SWITCH: —

	CONTACT #1	VOLTAGE DROP		CONTACT #2	VOLTAGE DROP	
ROOM TEMP. 28VDC 2.2AMPS						
	29.02	.24	.109 Ω	29.76	.24	.109 Ω
	29.08	.24	ΔR = .68	29.76	.24	
	29.05	.24		29.77	.24	
+165 °F	28.98 •	.24	ΔR = .82	29.80 •	.24	
10:23	28.99	.24		29.80	.24	
−320 °F						
10:24	29.90 •		ΔR = .79	30.69 •	.24	
	30.04			30.69	.24	
10:25	30.0	.22	.10 Ω	30.60	.24	
10:26	29.92			30.50		
10:29	27.50	.22	ΔR = 2.3	29.80	.22	.10 Ω
10:30	27.40	.22		29.50	.22	
6 CYCLES						
10:33	28.0	.21	.095 Ω	29.49	.22	
10:34	28.0	.21	ΔR = 1.3	29.30	.22	
10:35	28.0	.21		29.30		
10:36	28.0	.21		29.30	.21	.095 Ω
10:40	27.75		ΔR = 1.7	29.45	.25	
10:41	27.95	.22		29.45	.22	
10:45	27.95	.26	.118 Ω	29.70	.26	.118 Ω
11:46	27.85	.26	ΔR = 1.6	29.45	.26	
TEMP. TEST (CONT. FROM PAGE 4)						
+165 °F						
30 MIN.	29.10	.35	.106 Ω	29.90	.34	
3.3 AMPS,—30VDC.	29.01 •	.34	.103 Ω	29.91 •	.34	.103 Ω
	29.05	.35	ΔR = .85	29.90	.34	
+165 °F						
24 HRS. @ +165	28.78	.35	.109 Ω	29.82	.34	.106 Ω
29VDC.— 3.2 AMPS.	28.90	.35	ΔR = .94	29.84	.34	
	28.98 •	.35		29.86 •	.33	.103 Ω
	28.98	.35	ΔR = .98	29.88	.33	
ROOM RETURN						
AFTER +165 82 °F	28.88	.33	.103 Ω	29.80	.32	.10 Ω
29 VDC.	28.98	.31	ΔR = .82	29.80	.30	.093 Ω
3.2 AMPS.	29.05	.31	.096 Ω	29.80	.30	

TEST: PRESSURE CYCLE TEST CALIBRATION PORT **DATE:** 6-28-66

PERFORMED BY: R. DAVIS / J. STURLA

SWITCH ASSY: #30 PSIA. **VOLTAGE:** 30VDC. **CURRENT:** 3.2 AMPS.

SYSTEM PORT ☐ **CALIBRATION PORT** ☑

TEMPERATURE, AMBIENT: 88 °F **ATMOSPHERIC PRESSURE:**

SWITCH: —

CYCLES

Room Temp.

~	VOLTAGE DROP		VOLTAGE DROP	
40	.34	.106 Ω	.32	.10 Ω
100	.26	.081 Ω	.25	.078 Ω
117	.25	.078 Ω	.24	.075 Ω
130	.25		.25	
160	.23	.072 Ω	.23	.072 Ω
213	.23		.23	
256	.21	.066 Ω	.21	.066 Ω

PROOF PRESSURE 115 PSIG 5 MIN.

30 VDC.
3.2 AMPS.
USING HEISE GUAGE FOR READ OUT

CONTACT #1	VOLTAGE DROP		CONTACT #2	VOLTAGE DROP	
15.25 PSIG	.35	.11 Ω	16.0 PSIG	.35	.11 Ω
		Δ P.=.75			

TEST 4.3.3.3

CONTACT #1	VOLTAGE DROP		CONTACT #2	VOLTAGE DROP	
29.25	.35	.11 Ω	30.09	.35	.11 Ω
29.15	.34	.106 Ω	30.09	.34	.106 Ω
29.22	.34	Δ P.=.87	30.09	.34	

TEST: PRESSURE CYCLE TEST SYSTEM PORT DATE: 6-28-66

PERFORMED BY: R. DAVIS / J. STURLA

SWITCH ASSY: # 30 PSIA. VOLTAGE: 29VDC. CURRENT: 3.1 AMPS.

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 88°F ATMOSPHERIC PRESSURE: ______

SWITCH: —

CYCLES	~	CONTACT #1 VOLTAGE DROP		CONTACT #2 VOLTAGE DROP	VOLTS.
-320°F	30	.36	.116 Ω	.35	
	47	.35	.113 Ω	.36	
	66	.30	.096 Ω	.30	29 VDC.
	115	.31	.1 Ω	.30	29 VDC.
	197	.28	.090 Ω	.28	26 VDC.
	282	.28		.28	26 VDC.
	314	.36		.36	26 VDC.
	340	.30		.30	24 VDC.
	371	.24	.077 Ω	.24	(20.5 VDC. 2.5 AMPS.)
	430	.19	.061 Ω	.19	17.5 VDC.
	500	.18	.058 Ω	.19	17 VDC.

PROOF PRESSURE

@ -320		CONTACT #1	CONTACT #2
16 VDC.	1.7 AMPS	14.50 PSIA.	15.40 PSIA.

4.3.3.3	CONTACT #1	VOLTAGE DROP	CONTACT #2	VOLTAGE DROP
	28.52	.23	29.78	.23
	28.52	.23	29.79	.23
	28.52	.23	29.79	.24

TEST: VIBRATION – SINUSOIDAL **DATE:** 6/29/66

PERFORMED BY: R. DAVIS / E. WOOD / C. LAMBERT

SWITCH ASSY: 30 PSIA **VOLTAGE:** ______ **CURRENT:** ______

SYSTEM PORT ☑ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 75°F **ATMOSPHERIC PRESSURE:** ______

SWITCH: ______

TAPE SPEED = .25"/sec
GALVOS 0 – 3000 CPS

MB C10B VIBRATION TABLE

MODEL 5-124 CONS. ELEC. CORP. OSCILLOGRAPH RECORDER

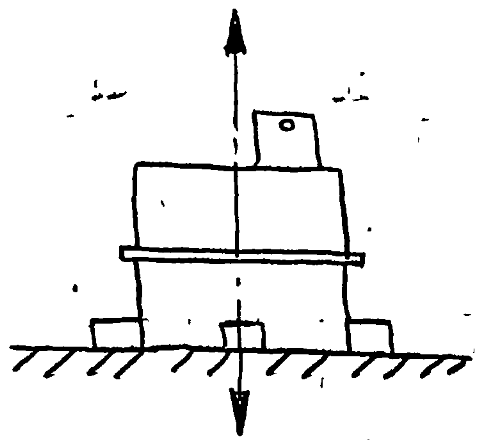
SCAN 5 → 2000 → 5 CPS @ 1 OCTAVE/MIN
5–38 CPS @ .4" DA
38 – 2000 CPS @ 30 G P to P

I PEAK TO PEAK	#1	#2	ΔP
	28.86	29.34	.48
ROOM	28.88	29.36	.48
	28.88	29.36	.48

6/30

	#1	#2	ΔP
	28.81	29.34	.53
	28.81	29.34	
	28.81	29.34	

CPS	#1	#2	ΔP
6	28.81	29.34	.53
7	28.81	29.34	
9.5	28.81	29.34	
11.5	28.81	29.34	
14	28.81	29.34	
18.5	.84	29.35	.51
26	.84	.35	.51
30	.84	.35	.51
33	.90	.32	.42
CUT OUT @ 40 38	.92	.38	.46
CROSSOVER	28.91	29.34	.43
VOID { 55		29.32	
VOID { 58	28.95	29.32	.37
40	28.98	29.32	.34
65	28.92	29.32	.40
	28.98	29.32	.34
120	28.98	29.32	.34
145	—	.32	
	—	.14	
300	—	.35	
370	28.84	29.38	.54
575	28.90	29.42	.52
750	28.70	29.45	.75
1000	28.00	29.00	1.00
1600	28.10	29.70	1.60
2000	28.45	29.45	1.00



DIRECTION OF VIBRATION (VERTICAL)

2000 CPS 28 – 30 psi FOR MAKE POINT
↓
1000
900 28½ – 30 psi
500 29 – 29.5 psi

53 CPS BRASS FLARED FITTING TO SWITCH BROKEN

TEST: VIBRATION (CONTINUED) DATE: 6/30/66

PERFORMED BY: R. DAVIS / C. WOOD / E

SWITCH ASSY: 30 psia VOLTAGE: CURRENT:

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 75°F ATMOSPHERIC PRESSURE:

SWITCH:

30 G'S 2000 → 5 CPS CYCLED BETWEEN

2000 → 1000 CPS 28-30 psi FOR MAKE POINT

900 CPS 28.5-30 psi

500 CPS 29-29.5

53 CPS BRASS FITTING TO SYSTEM PORT BROKEN

CHECK MAKE POINT

#1	#2	ΔP
29.00 psia	29.30 psia	.30 psid
29.00	29.30	.30
29.00	29.30	.30

53 CPS < .5 psid
↓
CROSS-OVER PT. 40 CPS
↓
0 CPS

29.30	29.35	.05
29.30	29.35	.05
29.30	29.40	.1
29.30	29.40	.1

IA DETERMINE PRESSURE HOLD TO MAINTAIN CONTACT

30 G'S 5 → 2000 CPS

ON #1 CONTACT

29.30 REDUCE BY .5 psi

7 CPS 28.80

36 "

500 28.75

700 28.60

↓

2000

#2 NOT FUNCTIONING

TEST: TEMP. TEST (ROOM TEMP. TO L. HELIUM) **DATE:** 6/30/66

PERFORMED BY: SPOONER/DAVIS/STURLA/LAMBERT

SWITCH ASSY: 30 psia **VOLTAGE:** 30 VDC **CURRENT:** 3.2 AMPS

SYSTEM PORT ☑ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 90°F **ATMOSPHERIC PRESSURE:** 1005.1 MB

SWITCH:

1. ACTUATION – DEACTUATION READINGS WERE TAKEN @:
   a. ROOM TEMP.
   b. LN TEMP.
   c. L HELIUM TEMP.

ROOM TEMP. (90°F)

	#1	VOLTAGE DROP		ΔP	#2	VOLTAGE DROP	
	• 29.08	.28	.09Ω	.64	29.72 •	.62	.19Ω
	29.12	.28		.60	29.72	.38	.12Ω
	29.12	.28		.60	29.72	.3	.09Ω
	—	—			29.72	.38	
−320°F	28.50	.27		1.35	29.85	.7	.2Ω
	28.20				—		
	28.20			.88	29.08 •		
	28.15	.26		.97	29.12	.48	.15Ω
15 MIN	28.12	.26		1.00	29.12	.45	.14Ω
45 MIN.	28.10	—		1.35	29.45 •	.4	.12Ω
	28.10	.25	.08Ω	1.28	29.38	.4	
	28.10	.25		1.22	29.32	.46	.14Ω
	28.10	.25			29.32	.35	.11Ω
	28.10	.25			29.32	.5 → .7	.2Ω MAX
	• 28.10	.25			29.32	.6 → .35	
LIQUID HELIUM −452°F	27.85	.23	.07Ω		—		
	28.05			1.45	29.50 •		
	• 28.00			1.40	29.40		
	28.08			1.37	29.45		
	28.08				29.45	.48	.15Ω
15 MIN	28.10	.24		1.35	29.45	.48	

1. SERIES OF ERRATIC READINGS, INADVERTENT OVERPRESSURE TO 100 PSIA
2. SWITCH FUNCTIONED AS THOUGH DIAPHRAGM CAVITY WAS FROZEN SOLID NOT ALLOWING CONTACT TO CHANGE POSITION.
3. PERMANENT CHANGE IN SET POINT OBSERVED
4. RE-TEST

TEST: TEMP. TEST (ROOM TEMP TO L. HELIUM) **DATE:** 6/30/68

PERFORMED BY: SPOONER/DAVIS/STURLA/LAMBERT

SWITCH ASSY: 30 psia **VOLTAGE:** 24 VDC **CURRENT:** 2.6 AMPS

SYSTEM PORT ☑ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 85°F **ATMOSPHERIC PRESSURE:** 1005.1 MBS

SWITCH: ____________

REPEAT ACT.-DEACT. TEST @ ROOM, LN TEMP., & L He TEMP. FOLLOWING CHANGE IN SET POINT.

	#1	VOLTAGE DROP		ΔP	#2	VOLTAGE DROP	
ROOM TEMP (85°F)							
	7.52 psia	.3	.11Ω	1.1 psid	8.62 psia	.3	.11Ω
	7.55	.3	.11Ω	1.07	8.62	.3	.11Ω
	7.58			1.02	8.60		
-320°F							
20 MIN	6.34			1.66	8.00	.25	.096Ω
	6.25	.25	.096Ω	1.83	8.18	.25	
	6.35	.25		1.65	8.00	.25	
	6.35	.25		1.90	8.25	.25	
25 MIN	6.35	.25		1.77	8.12		
LIQUID HELIUM -452°F							
	5.70	—		1.70	7.40	.34	.13Ω
	5.65			1.95	7.60		
	5.75			1.90	7.65		
	5.75			1.95	7.70		
	5.65			1.90	7.55		
	5.70			1.95	7.65		
	5.75			2.05	7.80		
	5.75			1.80	7.55	.40	.15Ω
	5.75			1.75	7.50		
	5.75			1.80	7.55	.38	
	5.75	.28	.11Ω	1.95	7.70	.29	
	5.75	.26	.15Ω	1.95	7.70	.25	
	5.75				—		
	5.70	.24	.09Ω	2.12	7.82		
	5.75	.24		1.95	7.70	.24	
30 MIN.	5.75				—		
	5.70	.24		1.80	7.50		
	5.75	.23		1.75	7.50	.24	
	5.75	.22	.085Ω	1.75	7.50	.23	
	5.75			1.75	7.50	.3	
	5.75				—		

TEST: TEMP. TEST (ROOM TEMP. TO L. HELIUM) DATE: 6/30/66

PERFORMED BY: SPOONER/DAVIS/STURLA/LAMBERT

SWITCH ASSY: 30 psia VOLTAGE: 24 VDC CURRENT: 2.6 AMPS

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 85°F ATMOSPHERIC PRESSURE: 1005.1 MB

SWITCH: ________

(CONTINUED)

-452°F	#1	VOLTAGE DROP	ΔP	#2	VOLTAGE DROP	
	5.75		2.15 psid	7.90	.25	
	5.75	.23	2.05	7.80	.24	
	5.75	.22	1.85	7.60		
	5.70		2.20	7.90		
	5.75	.23	1.95	7.70	.24	
	5.75	.23	1.90	7.65	.26	.1Ω
	5.75		1.85	7.60		
	5.75			—		
	5.85			—		
	5.75		1.95	7.70		

LIQUID HELIUM IN CONTAINER

TEST: PRELIM. PROCESSING & TESTING DATE: 6/9/66

PERFORMED BY: R. DAVIS

SWITCH ASSY: 45 PSIA VOLTAGE: — CURRENT: —

SYSTEM PORT ☐ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: ________ ATMOSPHERIC PRESSURE: ________

SWITCH: ________

1. ULTRASONICALLY CLEAN SWITCH PRIOR TO WELDING 6/8
2. CHECK ACTUATION - DEACTUATION PRESSURE PRIOR TO 6/9
ATTACHING WIRES TO COVER

#1	#2	ΔP
55.09 PSI	55.80 PSI	.71 PSID

3. SOLDER WIRES AND PLACE COVER ON UNIT & TEMP. CYCLE

55.00	55.80	.80

4. HELI-ARC COVER TO HOUSING (CURRENT 86 AMPS)

55.13	55.88	.75	(UNIT STILL WARM)

5. CLEAN SWITCH & CHECK ACT.-DECT. PRESS @ ROOM TEMP. 6/10

55.02	55.80	.78

6. LEAK CHECK COVER CHAMBER (CONNECTOR, WELD, DIFFERENTIAL SCREW, AND SYSTEM PORT)
NO LEAKAGE (10^{-9} ATMOSPHERES He/cm^3/SEC
7. OUTGAS COVER CHAMBER
   a. 190°F, 2.5 HRS, VACUUM 7-8 MICRONS OF Hg
   b. GRADUAL RETURN TO ROOM TEMP. WITH VACUUM ON BACKFILL TUBE
8. BACKFILL WITH PURIFIED NITROGEN (278 MBS)
TEMP. OF GREY ROOM 72°F
9. CHECK ACT.-DEACT. PRESS @ ROOM TEMP.

#1	#2	ΔP
43.85 psia	44.65 psia	.8 psid
43.85	44.65	.8
43.85	44.65	.8

14.6 PSIA 81.5°F 6/13

10. a. PRESSURIZE SWITCH THRU SYSTEM PORT @ 120 psig. LAST 4 CYCLES HOLD 120 psig PRESSURE FOR 5 MIN.

$\boxed{81.5°F}$

	#2 (HEISE GAGE)	
(44.9 PSIA)	30.3 psig	
(44.9)	30.3 psig	5 CYCLES @ 121 psig

TEST: PRELIMINARY PROCESSING & TESTING **DATE:** 6/13/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 45 PSIA **VOLTAGE:** 6 V **CURRENT:** 40 Ma

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: _____ **ATMOSPHERIC PRESSURE:** _____

SWITCH: _____

10.a. PRESSURE CYCLE @ 120 psig (CONTINUED)

		#2	
	(44.9 psia)	30.3 psig	10 CYCLES @ 121 psig
LEAK IN CAL. SHELL	(44.9)	30.3	15 "
	(44.9)	30.3	17 CYCLES @ 121 psig 5 MIN
	(44.8)	30.2	18 "
	(44.7)	30.1	"
	(44.7)	30.1	"

b. SUBMERGE SWITCH IN LIQUID NITROGEN DETERMINING CHANGE IN OPERATING POINT $\boxed{-320°F}$

	#2
(42.6)	28 psig
(42.6)	28
(42.6)	28
(42.6)	28

c. DETERMINE CHANGE IN OPERATING POINT @ $\boxed{+165°F}$ AND PRESSURE CYCLE @ 120 psig 5 CYCLES, 5 MIN.

(45.1)	30.5 psig				
(45.1)	30.5				
(45.1)	30.5				
(45.3)	30.7	1	CYCLE	120 PSIG	10 MIN
(45.3)	30.7	2	"	"	5 MIN
(45.4)	30.8	3		"	
(45.4)	30.8	4		"	
(45.4)	30.8	5		"	

ROOM RETURN $\boxed{81.5°F}$

(45)	30.4 psig
(45)	30.4
(45)	30.4

11. BACKFILL WITH 91 MBS PURIFIED NITROGEN 6/14 999 MB Hi 38

#1	#2	ΔP	
(41.58 psia)	27.2 PSIG		HEISE GAGE $\boxed{81°F}$
40.70	41.60 PSIA		ABSOLUTE PRESSURE GAGE
40.75	41.60	.85 psid	
40.70	41.60	.90	

TEST: PRELIMINARY PROCESSING & TESTING **DATE:** 6/14/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 45 PSIA **VOLTAGE:** 6 V **CURRENT:** 40 Ma

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: ______ **ATMOSPHERIC PRESSURE:** ______

SWITCH: ______

*

11. BACKFILL 91 MB (CONTINUED)

RESET DIFF. SCREW $\boxed{+81°F}$

#1	#2	ΔP
41.70	42.58 psia	.88
41.70	42.60	.90
41.70	42.60	.90
41.70	42.60	.90

ABS. PRESS GAGE

CHECK ACT. – DEACT PRIOR TO LN TEMP 1:15 $\boxed{+81°F}$

41.52	42.50 psia	.98
• 41.48	• 42.50	1.01
41.48	42.38	.90
41.48	42.48	1.00
41.48	42.48	1.00

ACT. – DEACT. PRESSURE WITH UNIT SUBMERGED LN $\boxed{-320°F}$

41.30	42.52	1.22
• 41.25	• 42.55	1.30
41.25	42.55	1.30
41.25	42.55	1.30

ACT. – DEACT. PRESSURE WITH UNIT @ / $\boxed{+165°F}$

• 41.61	• 42.51	.90
41.61	42.51	.90
41.61	42.51	.90

ACT – DEACT. PRESSURE WITH UNIT @ ROOM TEMP. $\boxed{+81°F}$

41.48	42.48	1.02
41.48	42.50	1.02
41.48	42.50	1.02

CHECK PRIOR TO PRESSURIZING THRU CAL. PORT

6/16
80°F
SETTING CHANGE

41.20	42.10	.90
41.20	42.10	.90
41.20	42.10	.90
41.20	42.10	.90

TEST: PRELIMINARY PROCESSING & TESTING DATE: 6/16/66

PERFORMED BY: E. CAVIS / C. LAMBERT

SWITCH ASSY: 45 PSIA VOLTAGE: 6V CURRENT: 40 MA

SYSTEM PORT ☐ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: ATMOSPHERIC PRESSURE:

SWITCH:

12. CALIBRATION PORT ACTUATION - DEACT.

#1	#2	ΔP	
42.70	43.60	.9	DATA NOT RELIABLE DUE TO LEAKAGE
42.7	43.6	.9	

LEAK RATE WITH CALIB. PORT OPEN 1 psi / SEC

13. SYSTEM PORT RE-CHECK

41.17	42.10	.93
41.17	42.10	.93
41.17	42.10	.93

TEST: EVALUATION TESTS **DATE:** 6/20/66

PERFORMED BY: R. DAVIS

SWITCH ASSY: 45 psia **VOLTAGE:** ______ **CURRENT:** ______

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 80°F **ATMOSPHERIC PRESSURE:** 1008.4

SWITCH: ______

DIELECTRIC STRENGTH

#1	#2
41.18 psia	42.10 psia
41.18	42.10
41.18	42.10

#1 CONTACT PIN (A) TO SWITCH BODY 600 VAC
#2 " (B) " " " 400 VAC

#1 " (A) " COMMON CONTACT 400 VAC
#2 " (B) " " 400 VAC

#1	#2
41.21	42.12
41.15	42.08
41.15	42.10

PIN (C) COMMON CONTACT TO SWITCH BODY 675 VAC 6/21

CIRCUIT RESISTANCE

	#1	#2
	41.18	42.22
	41.18	42.22
28VDC Ma 100	.18	1.0
Ma 200	.18	.39
Ma 300	.18	.39

INSULATION RESISTANCE 500 VAC

#1	#2
41.22	42.20
.22	42.18

PIN	C	TO	CASE	INFINITY
	A	TO	CASE	"
	B	TO	CASE	"
	A	TO	C	"
	B	TO	C	"

TEST: PROOF PRESSURE (4.3.3.2) DATE: 6/23/66

PERFORMED BY: DAVIS

SWITCH ASSY: 45 PSIA VOLTAGE: 30 VDC CURRENT: 50 Ma

SYSTEM PORT ☐ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 80°F ATMOSPHERIC PRESSURE: 1007.0

SWITCH: 80°F 14.6 psia

SYSTEM PORT

	#1	#2
	27.0 PSIG	27.52 PSIG
	(41.6) psia	(42.12)

CALIBRATION PORT

	#1	#2
	27.0 PSIG	27.50 PSIG
	(41.6)	(42.10)

TEST: SETTINGS (ACT.-DEACT. PRESS.) CIRCUIT RESISTANCE   DATE: 6/23/66

PERFORMED BY: R. DAVIS / J. STURLA

SWITCH ASSY: 45 PSIA   VOLTAGE: 30 VDC   CURRENT: 50 Ma

SYSTEM PORT [✓]   CALIBRATION PORT [ ]

TEMPERATURE, AMBIENT: 80°F   ATMOSPHERIC PRESSURE: 1007 MB

SWITCH: —

SYSTEM PORT	CONTACT #1	VOLTAGE DROP		CONTACT #2	VOLTAGE DROP	
ROOM TEMP.	41.15 PSIA	.005 V	.1Ω	42.22 PSIA	.006 V	.12Ω
	41.15	.005	ΔP=1.1	42.11	.006	
	41.15	.005		42.15	.006	
-320°F	• 40.88	.013	.26Ω	42.39 •	.011	.22Ω
	40.88	.011	ΔP=1.51	42.39	.013	
	40.88	.011		42.39	.009	
+165°F	41.15	.006	.12Ω	42.11	.006	.12Ω
	41.15	.006	ΔP=.96	42.11	.006	
	41.15	.006		42.11	.006	

• ΔP= 1.51 PSID

TEST: TEMPERATURE SHOCK & TEMP. TEST **DATE:** 6-27-66

PERFORMED BY: R. DAVIS / J. STURLA

SWITCH ASSY: #45 PSIA. **VOLTAGE:** — **CURRENT:** —

SYSTEM PORT ☑ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 90 °F **ATMOSPHERIC PRESSURE:**

SWITCH: —

FRIDAY = 41.48 PSIA.
MONDAY – 41.80 PSIA.

TEMP. SHOCK

RM. 20VDC 2.2 AMPS	CONTACT #1	VOLTAGE DROP		CONTACT #2	VOLTAGE DROP	
	40.75	.28	.13 Ω	41.80	.26	.12 Ω
	40.77	.28	ΔP. = 1.03	41.80	.26	
	40.77	.24	.11 Ω	41.80	.26	
+165°F						
9:42	40.80	.22	.10 Ω	41.88	.22	.10 Ω
	40.80	.23	.105 Ω ΔP. = 1.08	41.88	.22	
−320°F						
9:45	41.62	.22	.10 Ω	42.65	.22	.10 Ω
9:47	41.50	.22	ΔP. = 1.05	42.55	.22	
9:48	41.48	.22		42.45	.22	
9:49	41.50	.22	ΔP. = 1.00	42.50	.22	
9:50	41.00	.22		42.20	.22	
9:52	40.70	.22	ΔP. = 1.20	41.90	.22	
9:53	40.65	.22		41.89	.22	
9:54	40.60	.22	ΔP. = 1.29	41.89	.22	
9:55	40.60	.22		41.89	.22	
10:00	40.45	.21	.095 Ω	42.00	.22	
10:02	40.45	.21	ΔP. = 1.55	42.00	.22	
10:20	40.45	.21	ΔP. = 1.55	42.00	.22	

REMOVE FROM TEMPERATURE SHOCK — PUT ON TEMP TEST

4 HRS @ −320°F	40.42	.46	.15 Ω	42.13	.40	.13 Ω
30VDC 3 AMPS.	40.45	.57	.19 Ω	42.20	.42	.14 Ω
	40.48	.46	ΔP. = 1.97	42.45		
	40.48	.58	.19 Ω	42.10	.45	.15 Ω
				42.10	.45	
				42.10		

6/28/66

+165 45 MIN.	40.76	.35	.116 Ω	41.80	.33	.11 Ω
	40.77	.31	.10 Ω	41.80	.33	
	40.77	.34	ΔP. = 1.03	41.80	.33	
165 24 HRS.	40.25	.34	.106 Ω	41.30	.34	.105 Ω
29.5 VDC. 3.2 AMPS.	40.25	.34	ΔP. = 1.05	41.30	.34	
	40.25	.34		41.30	.34	

TEST: VIBRATION – SINUSOIDAL DATE: 6/30/66

PERFORMED BY: R. DAVIS / C. WOOD / LAMBERT

SWITCH ASSY: 45 PSIA VOLTAGE: CURRENT:

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 75°F ATMOSPHERIC PRESSURE:

SWITCH:

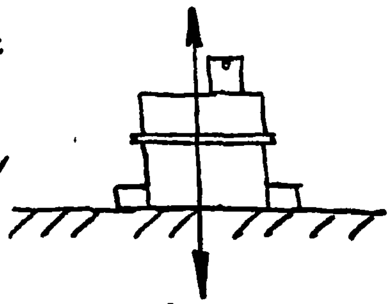
800 Ω's

MB C10B VIBRATION TABLE

MODEL 5-124 CONSOLIDATED ELECTRODYNAMICS CORP.
OSCILLOGRAPH RECORDER
TAPE SPEED = .25"/SEC
CEC. GALVANOMETERS #7-326, 0-3000 CPS

SCAN 5 → 2000 → 5 CPS @ 1.0 OCTAVE/MIN.
5 → 38 CPS @ .4" DA
38 → 2000 CPS @ 30 G PEAK TO PEAK

III



	#1	#2	ΔP
	40.02 psia	41.30 psia	1.28 psid
	40.04	41.30	1.26
	40.04	41.30	1.26
TABLE ON			
CPS			
5	40.10	41.30	1.20
7	40.10	41.30	
9.5	40.10	41.30	
12.5	40.10	41.30	
19	40.15	41.15	1.00
30	40.20	41.10	.90
40	40.20	41.10	
50	40.50	41.08	.58
60	40.60	41.08	.48
70	—	40.90	
95	40.65	41.08	.43
130	40.60	41.10	.50
170	40.55	41.10	.45
230	40.60	41.10	.50
300	40.60	41.10	
350	40.60	41.10	
500	40.40	41.30	.90
680	40.30	42.20	1.90
1000	40.20	42.40	2.20
1400	39.40	41.40	2.00

TEST: VIBRATION (CONTINUED) DATE: 6/30/66

PERFORMED BY: R. DAVIS / C. WOODS / LAMBERT

SWITCH ASSY: 45 PSIA VOLTAGE: ________ CURRENT: ________

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 75°F ATMOSPHERIC PRESSURE: ________

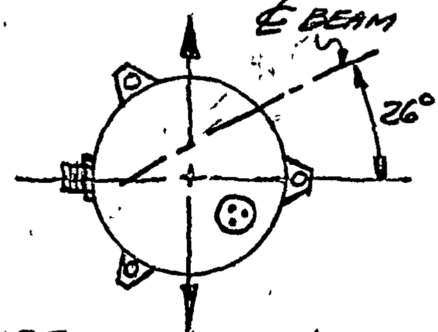
(CONTINUED) SWITCH: ________

CPS	#1	#2	ΔP
1750	39.60	41.25	1.65
~ 2000	39	42.50 / 46.50	
↓	ON #2 ONLY	42.00 → 43.00	.5 TO 1.5 # HOLD ON #2 CONTACT
1500			
750		CHATTER	
600		"	
	REDUCE TO	42.00	~ .5 # HOLD ON #2
150		↓	
↓ CROSSOVER @ 38 CPS			
0		42.00	
	40.45	41.45	
	40.35	41.45	
	40.30	41.45	
	40.30	41.45	

IIIA 10 G's 500 → 5000 CPS WITH COMMON CONTACT ON #2 CONTACT

CPS	#2
0	41.50
1800	CHATTER
2250 → 2500	"
3800 → 4300	"

IV CHANGE PLANE OF VIBRATION



DIRECTION OF VIBRATION (HORIZONTAL)

TEST: VIBRATION (CONTINUED) **DATE:** 6/30/66

PERFORMED BY: R. DAVIS / C. WOOD / LAMBERT

SWITCH ASSY: 45 PSIA **VOLTAGE:** ______ **CURRENT:** ______

SYSTEM PORT ☑ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 75°F **ATMOSPHERIC PRESSURE:** ______

SWITCH: ______

HORIZONTAL DIRECTION

5 → 38 CPS @ .4" DA

38 → 2000 CPS @ 30G PEAK TO PEAK

	#1	#2	ΔP
	40.20 psia	41.20 psia	1.00 psid
	40.20	41.20	
	40.20	41.20	
CPS			
5	40.20	41.20	1.00
9	40.20	41.20	
13	40.22	41.15	.93
17	40.25	41.10	.85
20	40.35	41.00	.65
30	40.35	40.95	.60
38	40.45	40.95	.50
TABLE OUT @ 45 CPS			
40	40.45	40.95	.50
50	40.45	40.95	.50
70	40.45	40.95	.50
90	40.40	40.90	.50
140	40.40	40.95	.55
170	40.35	40.98	.63
230	40.40	40.95	.55
300	—	.90	
650	40.45	41.70	1.25
—	40.45	41.15	.70
800	40.35	41.00	.65
1160	40.25	41.10	.85
1600	40.25	43.00	.75

2000 — 36 TO 44 PSI TO DAMPEN CHATTER
RAPID CYCLE ~ 1 PSI/8 SEC

1500 — 40.5 TO 45 PSI

1100 — 40.5 TO 42 psi

850 — 40.5 TO 42 psi

↓

0

40.80	41.70	.90
40.70	41.68	.98
40.78	41.68	.90

TEST: VIBRATION (CONTINUED) DATE: 6/30/66

PERFORMED BY: R. DAVIS / C. WOOD / LAMBERT

SWITCH ASSY: 45 PSIA VOLTAGE: ______ CURRENT: ______

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 75°F ATMOSPHERIC PRESSURE: ______

SWITCH: ______

IVA HORIZONTAL DIRECTION

30 G's 500 → 2000 CPS ON #2 CONTACT

	#2
40.70	41.68
40.70	41.68

COMMON CONTACT ON #2 CONTACT
0 CPS 41.70

575 CPS CHATTER

1500 → 2000 CPS " (CHATTER EXISTS WITH 46 psia APPLIED TO SYSTEM)

WITH 42 PSIA APPLIED TO #2 CONTACT SCAN FROM 2000 CPS DOWN TO 500 CPS

2000 ↓ 900 } CHATTER

750 ↓ 610 } CHATTER

500 CHATTER

	#1	#2	ΔP
0 CPS	41.30 psia	42.60 psia	1.3 psid
	41.40	42.60	1.2
	41.40	42.60	1.2
	41.40	42.60	1.2

(COMMON CONTACT NOT AT MAKE POINT. CONTRIBUTING TO CHATTER)

TEST: TEMP. TEST (ROOM TEMP TO L. HELIUM) DATE: 6/30/66

PERFORMED BY: SPOONER/DAVIS/STURLA/LAMBERT

SWITCH ASSY: 45 psia VOLTAGE: 28 VDC CURRENT: 3 AMPS

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 90°F ATMOSPHERIC PRESSURE: 1005.1 MB

SWITCH: ____________

1. ACTUATION – DEACTUATION READINGS WERE TAKEN:
   a. AT ROOM TEMP.
   b. AT L NITROGEN TEMP.
   c. AT L HELIUM TEMP.

ROOM TEMP. (90°F)

	#1	VOLTAGE DROP		ΔP	#2	VOLTAGE DROP	
	41.30	.3	.1Ω	1.28	42.58	.3	
	41.42	.3		1.10	42.52	.3	
	41.40	.3		1.15	42.55	.3	
	41.40	.3		1.15	42.55	.3	
−320°F							
10 MIN	40.86	–		1.36	42.22	.33	
	40.80	.34	.11Ω	1.48	42.28	.33	
	40.80	.34		1.52	42.32	.33	
	40.80	.33		1.52	42.32	.32	
20 MIN	40.76	.34	.11Ω	1.62	42.38	.32	
	40.78	.33		1.60	42.38	.32	
	40.78	.33		1.60	42.38	.32	
LIQ. HELIUM							
−452°F	40.60	.4	.13Ω	1.85	42.45	.25	.08Ω
	40.70	.25	.08Ω	1.75	42.45	.25	
	40.70	.25		1.8	42.50	.28	.09Ω
	40.70			1.85	42.55		
	40.72			1.78	42.60		
10 MIN	40.90			2.00	42.90		
	40.90			2.00	42.90	.24	.08Ω
					42.80		
	41.20			1.60	42.80		
15 MIN.	41.00			1.80	42.80	.22	.07Ω

LIQUID HELIUM IN CONTAINER W/SOLID NITROGEN FOLLOWING ABOVE TESTING.

TEST: LIFE CYCLE DATE: 7-1-66

PERFORMED BY: R. DAVIS

SWITCH ASSY: 45 PSIA VOLTAGE: — CURRENT: —

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 85°F ATMOSPHERIC PRESSURE:

SWITCH:

31 VDC 3.2 AMP

90°F

#1	VOLTAGE DROP	#2		VOLTAGE DROP	
41.45	.36	42.65	ΔP 1.20	.35	
41.45	.36	42.66	1.19	.37	.12Ω
41.45	.36	42.66	1.19	.37	

500 CYCLES AT −320°

313 CYCLES AT −452° TOTAL CYCLES 813

VOLTAGE DROP AT −452°

#1		#2	
	.32		.32
	.32		.32

ROOM RETURN 88°F

41.50	.36	42.70	ΔP 1.20	.36	.11Ω
41.50	.36	42.70	1.20	.36	
41.50	.36	42.70	1.20	.36	

550 CYCLES AT +165° TOTAL CYCLES 1,363

41.50	.36	42.80	ΔP 1.30	.35	.11Ω
41.51	.35	42.80	1.29	.35	
41.50	.35	42.80	1.30	.35	

727 CYCLES AT ROOM 87°F TOTAL CYCLES 2,090

41.40	.36	42.68	ΔP 1.28	.35
41.38	.36	42.68	1.30	.35
41.38	.36	42.68	1.30	.36

500 CYCLES AT ROOM 90°F TOTAL CYCLES 2,590

41.30	.35	42.70	ΔP 1.40	.35
41.30	.35	42.70	1.40	.35
41.30	.35	42.70	1.40	.35

TEST: LIFE CYCLE DATE: 7-1-66

PERFORMED BY: R. DAVIS

SWITCH ASSY: 45 PSIA VOLTAGE: ______ CURRENT: ______

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: ______ ATMOSPHERIC PRESSURE: ______

SWITCH: ______

31.5 VDC 3.3 AMP.

1,200 CYCLES AT ROOM 87°F TOTAL CYCLES 3,790

#1	VOLTAGE DROP	#2	ΔP	VOLTAGE DROP
41.32	.36	42.72	1.40	.36
41.32	.36	42.73	1.41	.36
41.31	.36	42.72	1.41	.36

2,010 CYCLES AT ROOM 88°F 24 VDC 2.5 AMP TOTAL CYCLES 5800

41.30	.28	42.73	ΔP 1.43	.28
41.30	.28	42.72	1.42	.28
41.30	.28	42.72	1.42	.28

34 VDC 3.5 AMP

41.32	.38	42.75	ΔP 1.43	.38
41.32	.38	42.75	1.43	.38
41.32	.38	42.75	1.43	.38

1,620 CYCLES AT ROOM 87°F TOTAL CYCLES 7,420

41.28	.36	42.85	ΔP 1.57	.36
41.30	.36	42.85	1.55	.36
41.30	.36	42.85	1.55	.36

2,580 CYCLES AT ROOM 87°F 31 VDC 3.1 AMP TOTAL CYCLES 10,000

41.30	.35	42.85	ΔP 1.55	.36
41.32	.35	42.85	1.53	.36
41.32	.35	42.85	1.53	.36

600 CYCLES AT ROOM 88°F 31 VDC 3.1 AMP TOTAL CYCLES 10,600

41.30	.35	42.85	ΔP 1.55	.36
41.30	.35	42.85	1.55	.36
41.30	.35	42.85	1.55	.36

TEST: Over Pressure Life Test 0.001" DIAPHRAGM DATE: 5-25-66

PERFORMED BY: J. STURLA

SWITCH ASSY: TEST CHAMBER VOLTAGE: — CURRENT: —

SYSTEM PORT [✓] CALIBRATION PORT [✓]

TEMPERATURE, AMBIENT: 80° F ATMOSPHERIC PRESSURE: REGULATE;

SWITCH: — SPACE: SYSTEM TO CALIB. = .029
CALIB. TO STOP = .002
(CONVOLUTION TO CONVOLUTION)

Test #1

Test chamber was overpressured @ 125 PSIG., twenty times each port alternately, to insure the calibration diaphragm of it's maximum travell. The pressure was released immediatly upon reaching the 125 PSIG. The unit was then checked for a leak on the leak detector. The unit wouldn't pull down below 150 microns. This was due to leakage in the system, the cause mainly of the method of assembly of the test chamber.

Test # 2

Test chamber was over pressured @ the house pressure, 85 PSIG being the nominal pressure. The test chamber was given 1100 cycles in rapid succession, approximately 150 cycles per minute. The test method used was 100 cycles applied alternatly to each side, each side having a total of 1100 cycles. We again checked the unit on the leak-detector for leaks. Due to system leakage as mentioned in paragraph above, the unit wouldn't pull down below 100 microns.

Test #3

Test chamber was overpressured @ 125 PSIG. five times each port alternately holding each half cycle for five minutes at 125 PSIG. The test chamber was then taken apart for examination of the calibration diaphragm for defects.

Upon examining the diaphragm, we found no visual defects that would be harmful to the finished switch using this .001" thick calibration diaphragm as part of the unit.

Tests to be continued using the test chamber with the calibration diaph soft soldered in place.

5-25-66 J. Sturla

TEST: OVER PRESSURE LIFE TEST 0.001" DIAPHRAGM, SOLDERED IN TEST CHAMBER **DATE:** 6-16-66

PERFORMED BY: J. STURLA

SWITCH ASSY: TEST CHAMBER **VOLTAGE:** — **CURRENT:** —

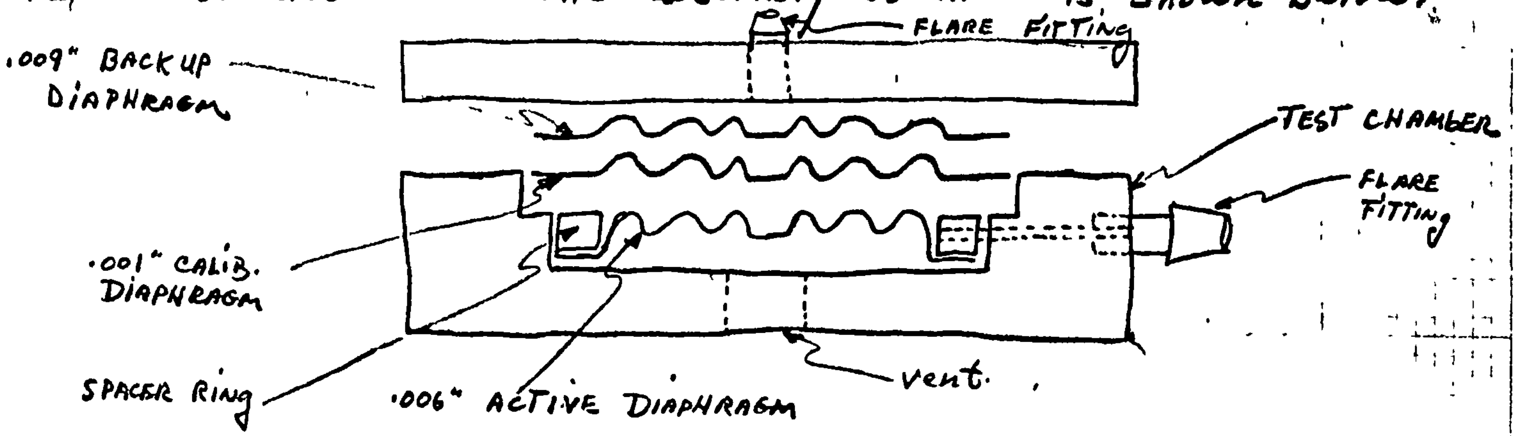
SYSTEM PORT ☑ **CALIBRATION PORT** ☑

TEMPERATURE, AMBIENT: 80 °F **ATMOSPHERIC PRESSURE:** REGULATED

SWITCH: — SPACE SYSTEM TO CALIB. = .029" CALIB. TO STOP = .002" (CONVOLUTION TO CONVOLUTION)

TEST # 1-1

All of the diaphragms were soldered in to the test - chamber for this test. The assembly of them is shown below.



On the top of each convolution of the .009" backup diaphragm is a hole to allow the pressure to enter the calibration chamber.

We overpressured the chamber to 135 PSIG. ten times each port alternately holding the pressure for five minutes each half cycle. Each half cycle was tested for leaks by submerging the test chamber in a beaker of trichloroethelene and watching for bubbles. NO leaks were detected on either side of calibration diaphragm.

TesT #2

The test chamber was then cycled rapidly @ 135 psig for ten cycles on each side of the calibration diaphragm and again subject to the bubble test. Again no leaks were detected.

TesT #3

Fify cycles @ 135 psig in rapid succession were applied to each side of the calibration diaphragm until a total of one hundred cycles were applied to each side. After bubble testing the unit and no leaks were found, we took the unit apart. We found the calibration diaphragm [illegible]

SUMMARY OF LIFE TEST .001" DIAPHRAGM

ACCUMULATIVE TOTAL CYCLES CAL. & SYSTEM DIAPHRAGM.

A- METHOD OF TEST OF CLAMPED UNIT

TEST 1

NORMAL CYCLE SPEED.
125 PSIG.

CALIBRATION DIAPHRAGM	SYSTEM DIAPHRAGM	
1 ~	125 #	
125 #	1	

ALTERNATE EACH ~

TOTAL ~ = 20	20	20

TEST 2

RAPID CYCLE
85 PSIG

CALIBRATION DIAPHRAGM	SYSTEM DIAPHRAGM	
100 ~	85 #	
85 #	100 ~	
TOTAL ~ 1100	1100	1120

TEST 3

5 MINUTE CYCLE
125 PSIG

CALIBRATION DIAPHRAGM	SYSTEM DIAPHRAGM	
1 ~	125 #	
125 #	1 ~	
TOTAL ~ 5	5	1125

B- METHOD OF TEST OF ALL SOLDERED UNIT

TEST 1

5 MINUTE CYCLE
135 PSIG.

CALIBRATION DIAPHRAGM	SYSTEM DIAPHRAGM	
1 ~	135 #	
135 #	1 ~	
TOTAL ~ 10	10	1135

TEST 2

RAPID CYCLE
135 PSIG

CALIBRATION DIAPHRAGM	SYSTEM DIAPHRAGM	
10 ~	135 #	
135 #	10 ~	
TOTAL ~ 10	10	1145

RAPID CYCLE
135 PSIG

TEST	CALIBRATION DIAPHRAGM	SYSTEM DIAPHRAGM	ACCUMULATIVE TOTAL CYCLES CAL. & SYSTEM DIAPHRAGMS
3	50 ~	135#	
	135#	50 ~	
	50 ~	135#	
	135#	50 ~	
TOTAL ~	100	100	1245

TEST: SALT SPRAY DATE: 5/25/66

PERFORMED BY: R. DAVIS/C. LAMBERT

SWITCH ASSY: TEST MODEL VOLTAGE:________ CURRENT:________

SYSTEM PORT ☐ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT:________ ATMOSPHERIC PRESSURE:________

SWITCH:________

SALT SPRAY PER MIL-E-5272 PROCEDURE I, FED. TEST METHOD STANDARD NO. 151 METHOD 811.

SALT SOLUTION 5% 50 HOUR MIN.

TEST MODEL INSERTED IN CHAMBER 5/25/66 2:00PM

VISUAL CHECK AFTER 50 HOURS 5/27/66 4:00 P.M.

1. WELD AREA @ COVER — NO VISIBLE CORROSION
2. WELD AREA @ DIAPHRAGM STOP ASSEMBLY — NO VISIBLE CORROSION
3. ALUM. BRONZE DIFFERENTIAL SCREW — DISCOLORATION, GREEN, AROUND 1/4"-60 THREADS

NOTE: RUST STREAKS ON HOUSING ATTRIBUTED TO CHAMBER RESIDUE

TEST MODEL REPLACED IN SALT SPRAY CHAMBER 4:15PM

VISUAL CHECK AFTER 144 HOURS 5/31/66 4:00 PM

1. WELD AREA @ COVER — NO CORROSION
2. " " @ DIAPHRAGM STOP ASSEMBLY — NO CORROSION
3. CORROSION APPEARED IN THE FOLLOWING AREAS (RUST COLOR)
   a. CALIBRATION STOP SCREW
   b. DIFFERENTIAL SCREW
   c. TERMINAL PIN IN CONNECTOR
   d. LOCK PIN ON CONNECTOR

VISUAL CHECK AFTER 336 HOURS 6/8/66 4:00 PM

1. WELD AREAS — NO CORROSION
2. CORROSION APPEARED IN THE FOLLOWING AREAS (RUST COLOR)
   a. CALIBRATION STOP SCREW
   b. DIFFERENTIAL SCREW
   c. TERMINAL PIN IN CONNECTOR
   d. LOCK PIN ON CONNECTOR

A DIAPHRAGM PLACED IN THE CHAMBER 5/31/66 4:00PM (192HRS) EXHIBITED CORROSION. THE CORROSION APPEARING ON THE TEST MODEL & DIAPHRAGM MAY HAVE BEEN STAINS CAUSED BY A FERROUS PART OF THE TEST CHAMBER AND NOT THE PIECE PARTS.

TEST: SHOCK TEST, ALNICO 5 MAGNET MATERIAL **DATE:** 6/20/66

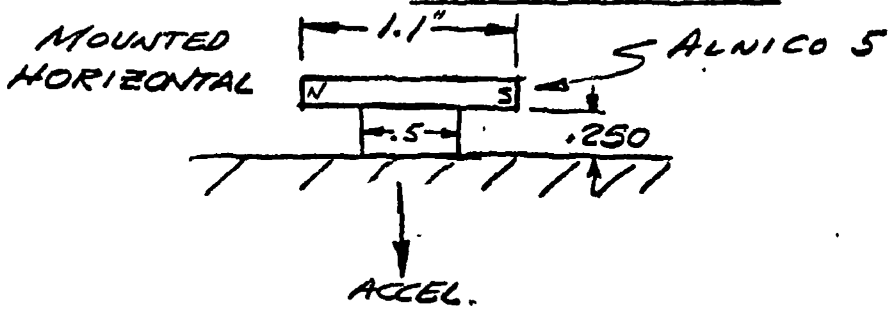
PERFORMED BY: R. DAVIS / L. WEBB

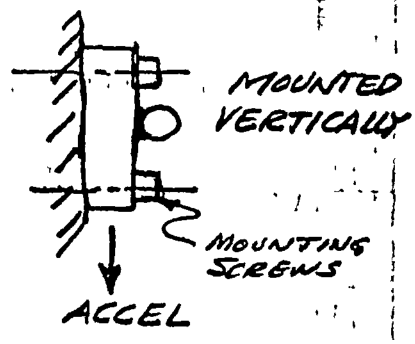
SWITCH ASSY: — **VOLTAGE:** — **CURRENT:** —

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 78°F **ATMOSPHERIC PRESSURE:**

SWITCH:





FOUR TEST SAMPLES WERE USED. ALNICO 5 MAGNETS SOLDERED TO BRASS PLATE

#2 MAGNET

FLUXMETER READING PRIOR TO TEST = 12 DIV. FOR ASSY 1, 2, & 4

(FLUXMETER READINGS AT THE NEUTRAL AXIS OF THE MAGNET SPECIMENS PRIOR TO SOLDERING
#1 17½ DIV. #3 17 DIV.
#2 16 DIV. #4 17 DIV.)

	"G" ACCEL.	MSEC	
HORIZ.	23	25	
	40	20	
	50	20	
	60	17	
	90	17	
	110	15	
	240	10	#1 PHOTO
	360	6.7	2 "
	530	2.5	3 "
	600	2.5	4 "
VERTICAL	620	~2.5	5 "

FLUXMETER READING FOLLOWING EACH SHOCK 12 DIV.

#1 MAGNET

	"G" ACCEL.	MSEC	
HORIZONTAL	360	6.7	#1 PHOTO
	530	2.5	2
	600	2.5	3
VERTICAL	600+	~2.5	4

FLUXMETER READING FOLLOWING EACH SHOCK 12 DIV.

#4 MAGNET

	"G" ACCEL.	M SEC	
HORIZONTAL	360	6.7	#1 PHOTO
	530	2.5	2
	600	2.5	3
VERTICAL	600+	~2.5	4

FLUXMETER READING FOLLOWING EACH SHOCK 12 DIV

#3 MAGNET WAS SHOCKED IN THE VERTICAL PLANE ONLY @ 580 G's FLUXMETER READING BEFORE AND AFTER TEST WAS 10 DIV.

TEST: DIELECTRIC STRENGTH CERAMIC INSUL. **DATE:** 6/20/66

PERFORMED BY: R. DAVIS / C. LAMBERT

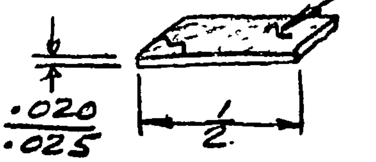
SWITCH ASSY: ______ **VOLTAGE:** ______ **CURRENT:** ______

SYSTEM PORT ☐ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: ______ **ATMOSPHERIC PRESSURE:** 1008.4

SWITCH: ______

METALLIZED SURFACE
TOP & BOTTOM



WIRE SOLDERED TO TOP & BOTTOM SURFACES
BREAKDOWN OCCURRED @ 1100 VAC 1ST TEST
650 VAC 2ND TEST

INSULATION RESISTANCE 5000 MEGOHMS 6/21

.032" THICK

WIRE SOLDERED TO TOP & BOTTOM SURFACES 6/21
BREAKDOWN OCCURS @ 2000 VAC
1100 VAC 60 SEC. O.K.

20 GAGE WIRE 2800 VAC NO BREAKDOWN THRU INSULATION 6/21

TEST: CENTRIFUGE – BEAM BALANCING DATE: 6/8/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 23, 30, 45 PSIA VOLTAGE: 6 VDC CURRENT: 40 MA

SYSTEM PORT ☑ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 82° F ATMOSPHERIC PRESSURE: 1004 MB

SWITCH: —

$G = 2.8416 \times 10^{-5} R N^2$ R = 34" @ BEAM
35" @ HOUSING BASE
N = RPM

RPM	#1	#2	ΔP	G's
	23 PSIA SWITCH			
0	33.05 PSI	33.35 PSI	.3 PSI	—
50	33.05	33.35	.3	2.42
75	33.05	33.35	.3	5.43
100	33.05	33.35	.3	9.66
150	33.02	33.32	.3	21.7
175	33.00	33.30	.3	29.6
200	33.00	33.30	.3	38.6
	30 PSIA SWITCH			
0	39.56	40.16	.6	
50	39.56	40.16	.6	
75	39.54	40.12	.58	
100	39.50	40.08	.58	
150	39.45	39.98	.53	
175	39.38	39.95	.57	
200	39.33	39.88	.55	
ADD WT. TO C'BAL. END OF BEAM				
0	39.58	40.21	.63	
50	39.58	40.21	.63	
75	39.56	40.20	.64	
100	39.53	40.17	.64	
150	39.52	40.11	.59	
175	39.52	40.11	.59	
200	39.52	40.11	.59	
0	39.55	40.18	.63	
	45 PSIA SWITCH			
0	54.55	55.41		
150	54.29	55.15		

ADD WEIGHT TO C'BAL. END OF BEAM

TEST: CENTRIFUGE – BEAM BALANCING **DATE:** 6/8/66

PERFORMED BY: R. DAVIS / C. LAMBERT

SWITCH ASSY: 23, 30, 45 PSIA **VOLTAGE:** 6 VDC **CURRENT:** 40 ma

SYSTEM PORT ☑ **CALIBRATION PORT** ☐

TEMPERATURE, AMBIENT: 82 °F **ATMOSPHERIC PRESSURE:** 1004 MB

SWITCH: —

45 PSIA SWITCH (CONTINUED)

RPM	#1	#2	ΔP	G's
0	54.47	55.31	.84	—
50	54.47	55.31	.84	2.42
75	54.47	55.31	.84	5.43
100	54.47	55.31	.84	9.67
150	54.47	55.31	.84	21.75
175	54.47	55.31	.84	29.6
200	54.47	55.31	.84	38.6
225	54.47	55.31	.84	49.1
0	54.47	55.31	.84	—

TEST: TEMPERATURE CYCLE (PROCESS) DATE: 6/8/66

PERFORMED BY: R. DAVIS

SWITCH ASSY: 23, 30, 45 VOLTAGE: — CURRENT: —

SYSTEM PORT ☐ CALIBRATION PORT ☐

TEMPERATURE, AMBIENT: 84°F ATMOSPHERIC PRESSURE: 1004

SWITCH: —

PROCESS THREE SWITCHES BETWEEN +165°F AND −320°F 5 TEMP. CYCLES (COVER OFF) LN @ WELDING FLANGE LEVEL

TIME	TEMPERATURE
10:45 A.M.	+165°F
11:00	−320°F
11:10	+165°F
11:30	−320°F
11:40	+165°F
12:10	−320°F
12:20	+165°F
1:00	−320°F
1:15	+165°F
1:40	−320°F

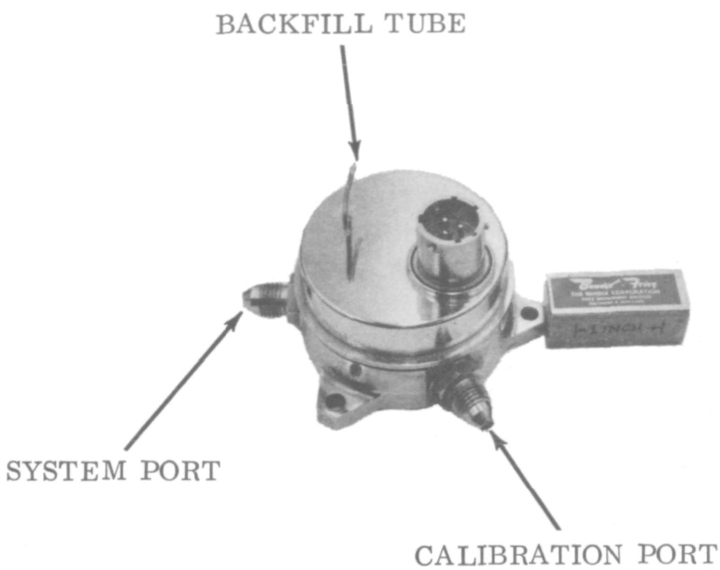
B. PHOTOGRAPHS

LIST OF PHOTOGRAPHS

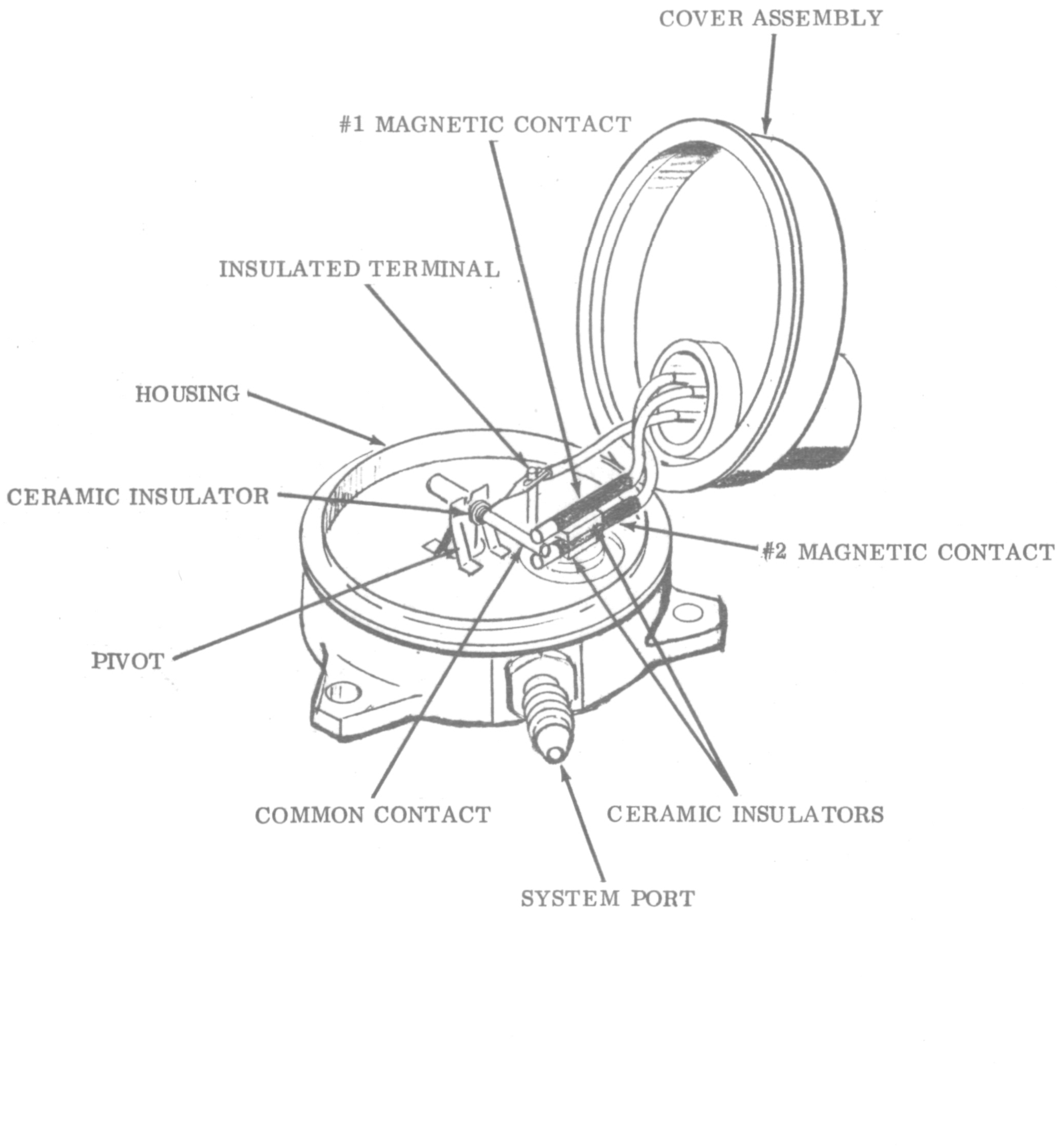
1. 30 psia Prototype Pressure Switch
2. 30 psia Prototype Pressure Switch (cover removed)
3. 30 psia Prototype Pressure Switch (bottom view)
4. Transfer Time, Setting Test, 23 psia Prototype Pressure Switch
5. Transfer Time, Life Cycle Test, 1100 Cycles, 23 psia Prototype Pressure Switch
6. Transfer Time, Life Cycle Test, 4250 Cycles, 23 psia Prototype Pressure Switch
7. Transfer Time, Temperature Shock Test at -320 °F, 23 psia Prototype Pressure Switch
8. Transfer Time, Temperature Test at Room Temperature, 30 psia Prototype Pressure Switch
9. Transfer Time, Temperature Test at +165 °F, 30 psia Prototype Pressure Switch
10. Transfer Time, Temperature Test at -320 °F, 30 psia Prototype Pressure Switch, Calibration Port.
11. Transfer Time, Life Cycle Test, 3500 Cycles, 45 psia Prototype Pressure Switch
12. Transfer Time, Life Cycle Test, 5800 Cycles, 45 psia Prototype Pressure Switch
13. Transfer Time, Life Cycle Test, 10600 Cycles, 45 psia Prototype Pressure Switch
14. Test Fixture for Cycling .001" Calibration Diaphragm (cover removed)
15. Shock Test, Alnico 5 Magnet Material

C. CALCULATIONS

1

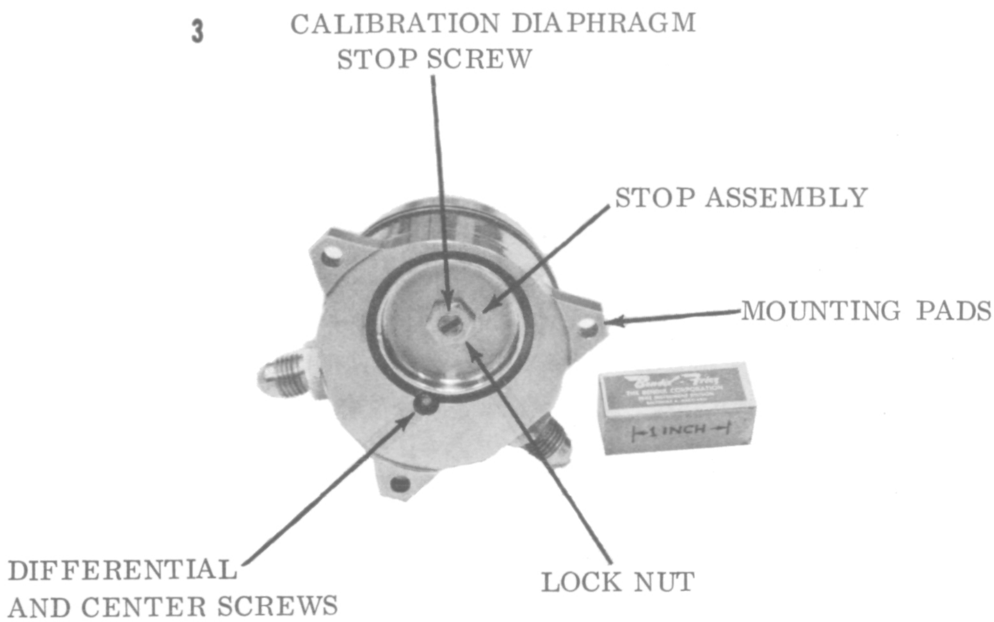


30 PSIA PROTOTYPE PRESSURE SWITCH



30 PSIA PROTOTYPE PRESSURE SWITCH (cover removed)

3



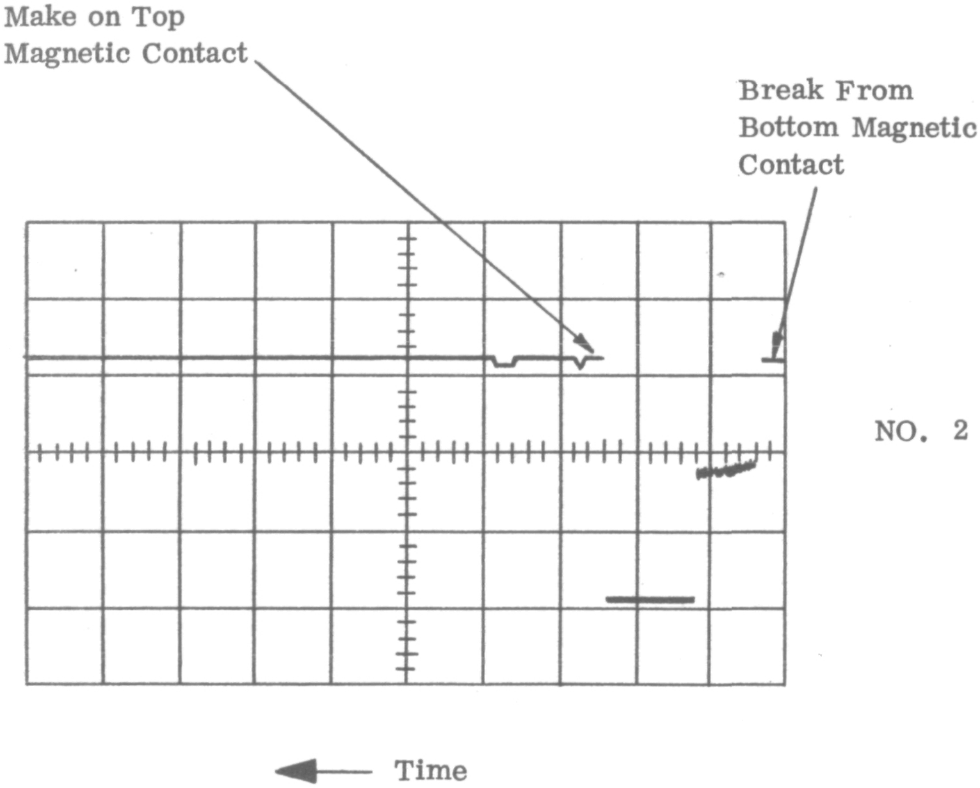
30 PSIA PROTOTYPE PRESSURE SWITCH (bottom view)

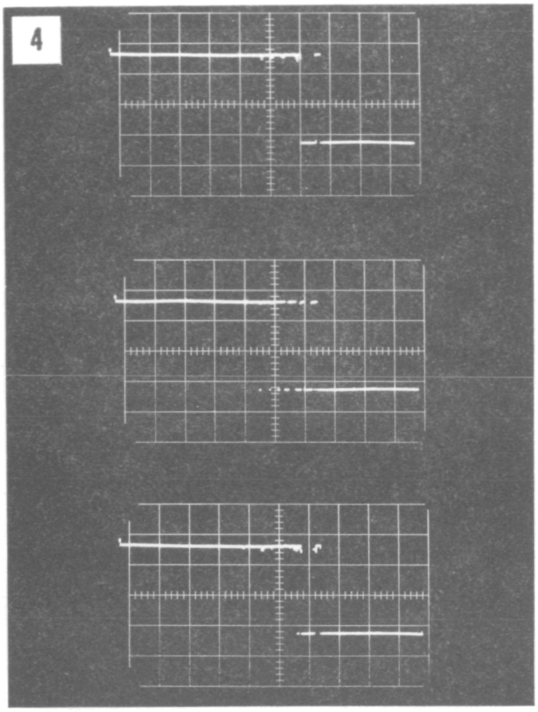
TRANSFER TIME INDICATED IN THE FOLLOWING PHOTOGRAPHS ARE KEYED AS FOLLOWS:

No. 1 Indicates breaking contact from the top magnetic contact, (Low Pressure Contact).

No. 2 Indicates breaking contact from the bottom magnetic contact, (High Pressure Contact).

Example:





NO. 2

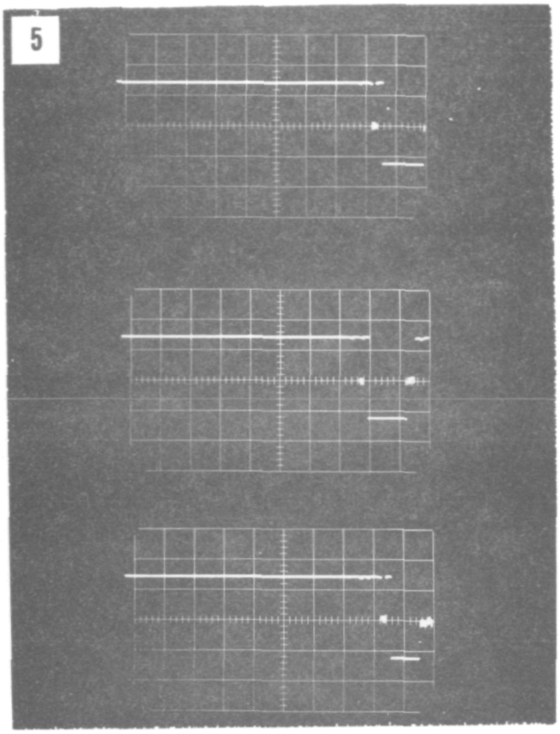
NO. 1

NO. 2

TIME

HORIZONTAL SCALE	1 MSEC PER DIVISION
VERTICAL SCALE	10 VOLTS PER DIVISION
CIRCUIT POTENTIAL	28 VDC
CIRCUIT CURRENT	50 MILLIAMPERES

TRANSFER TIME, SETTING TEST, 23 PSIA PROTOTYPE PRESSURE SWITCH



NO. 2

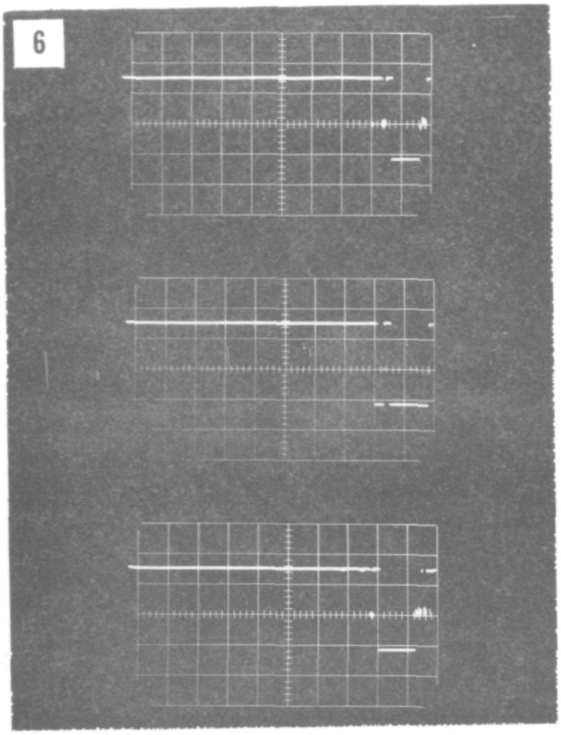
NO. 1

NO. 2

← TIME

HORIZONTAL SCALE	1 MSEC PER DIVISION
VERTICAL SCALE	10 VOLTS PER DIVISION
CIRCUIT POTENTIAL	28 VDC
CIRCUIT CURRENT	3 AMPERES

TRANSFER TIME, LIFE CYCLE TEST, 100 CYCLES, 23 PSIA PROTOTYPE PRESSURE SWITCH



NO. 2

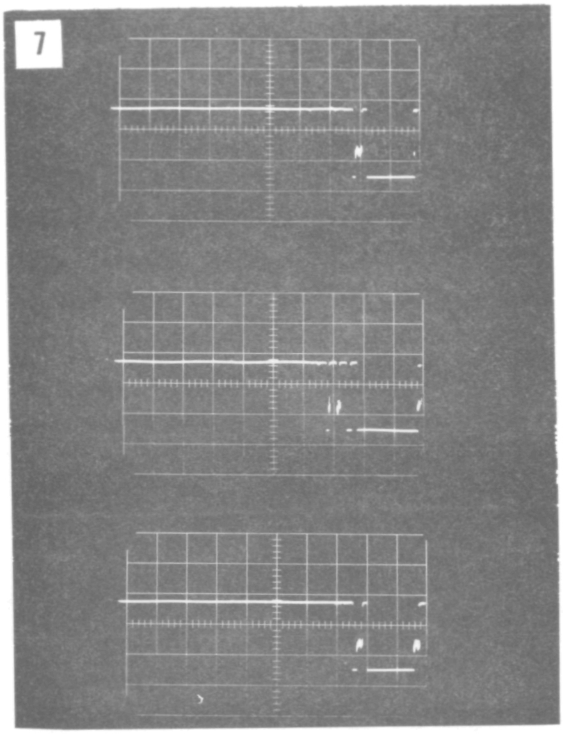
NO. 1

NO. 2

TIME

HORIZONTAL SCALE	1 MSEC PER DIVISION
VERTICAL SCALE	10 VOLTS PER DIVISION
CIRCUIT POTENTIAL	28 VDC
CIRCUIT CURRENT	3 AMPERES

TRANSFER TIME, LIFE CYCLE TEST, 4250 CYCLES, 23 PSIA PROTOTYPE PRESSURE SWITCH



NO. 2

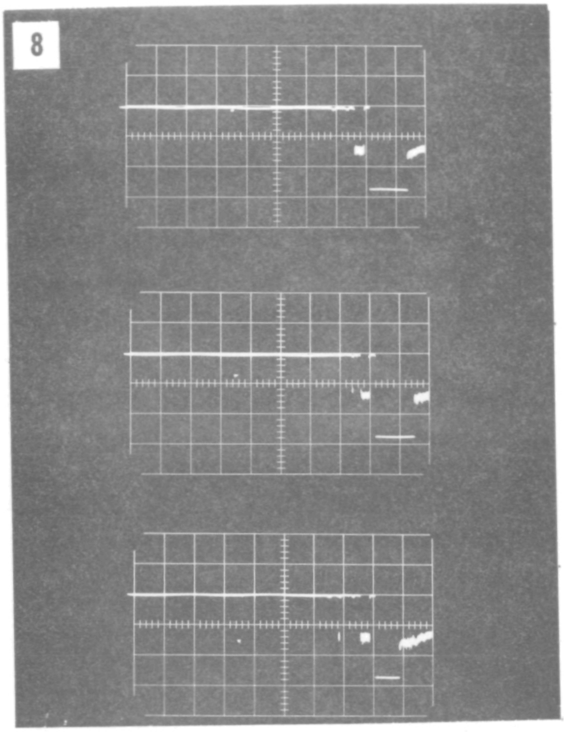
NO. 1

NO. 2

TIME

HORIZONTAL SCALE	1 MSEC PER DIVISION
VERTICAL SCALE	10 VOLTS PER DIVISION
CIRCUIT POTENTIAL	28 VDC
CIRCUIT CURRENT	3 AMPERES

TRANSFER TIME, TEMPERATURE SHOCK TEST AT -320 °F, 23 PSIA PROTOTYPE PRESSURE SWITCH



NO. 1

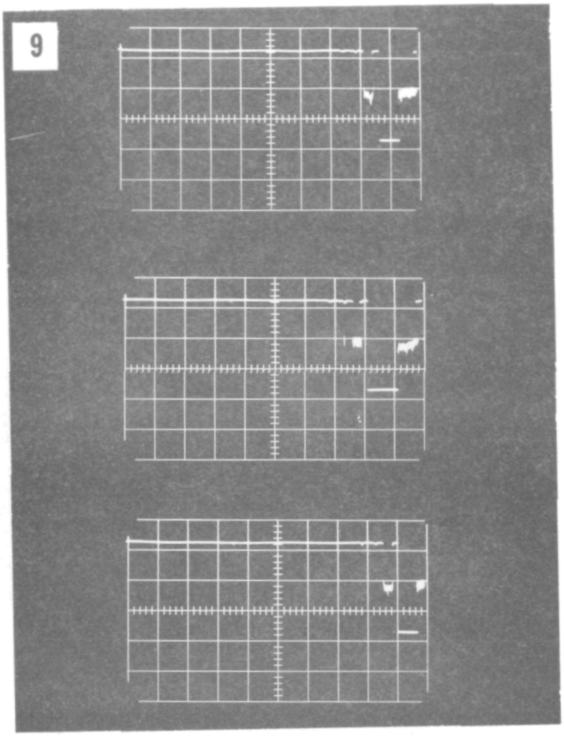
NO. 2

NO. 1

← TIME

HORIZONTAL SCALE	1 MSEC PER DIVISION
VERTICAL SCALE	10 VOLTS PER DIVISION
CIRCUIT POTENTIAL	29.5 VDC
CIRCUIT CURRENT	3.2 AMPERES

TRANSFER TIME, TEMPERATURE TEST AT ROOM TEMPERATURE, 30 PSIA PROTOTYPE PRESSURE SWITCH



NO. 1

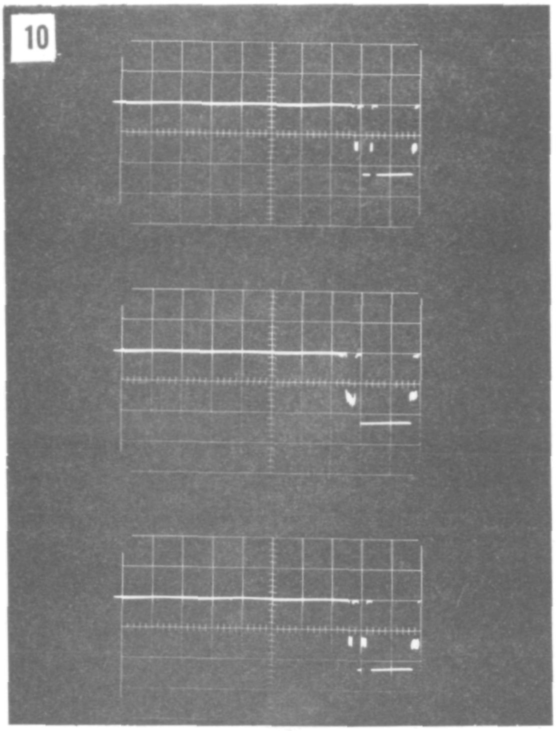
NO. 2

NO. 1

TIME

HORIZONTAL SCALE	1 MSEC PER DIVISION
VERTICAL SCALE	10 VOLTS PER DIVISION
CIRCUIT POTENTIAL	29.5 VDC
CIRCUIT CURRENT	3.2 AMPERES

TRANSFER TIME, TEMPERATURE TEST AFTER 24 HOURS AT +165 °F, 30 PSIA PROTOTYPE PRESSURE SWITCH



NO. 2

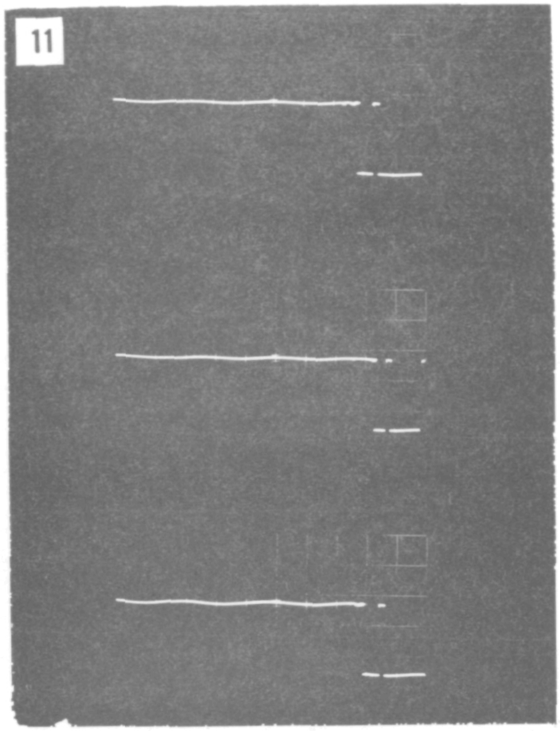
NO. 1

NO. 2

TIME

HORIZONTAL SCALE	1 MSEC PER DIVISION
VERTICAL SCALE	10 VOLTS PER DIVISION
CIRCUIT POTENTIAL	24 VDC
CIRCUIT CURRENT	2.6 AMPERES

TRANSFER TIME, TEMPERATURE TEST AT -320 °F, 30 PSIA PROTOTYPE PRESSURE SWITCH, CALIBRATION PORT



NO. 1

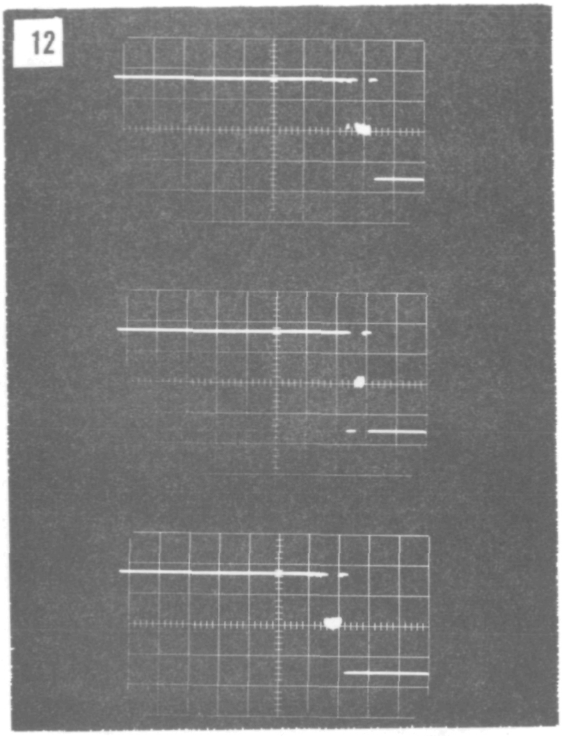
NO. 2

NO. 1

← TIME

HORIZONTAL SCALE	1 MSEC PER DIVISION
VERTICAL SCALE	10 VOLTS PER DIVISION
CIRCUIT POTENTIAL	24 VDC
CIRCUIT CURRENT	2.6 AMPERES

TRANSFER TIME, LIFE CYCLE TEST, 3500 CYCLES, 45 PSIA PROTOTYPE PRESSURE SWITCH



NO. 2

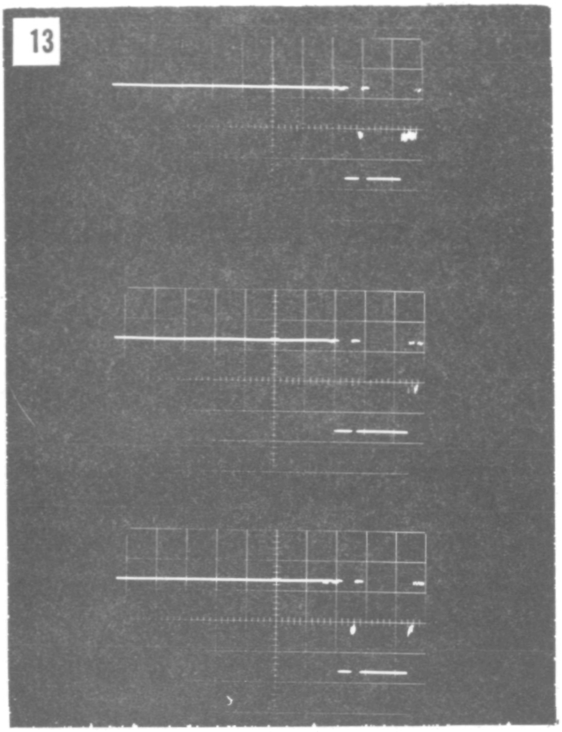
NO. 1

NO. 2

← TIME

HORIZONTAL SCALE	1 MSEC PER DIVISION
VERTICAL SCALE	10 VOLTS PER DIVISION
CIRCUIT POTENTIAL	34 VDC
CIRCUIT CURRENT	3.5 AMPERES

TRANSFER TIME, LIFE CYCLE TEST, 5800 CYCLES, 45 PSIA PROTOTYPE PRESSURE SWITCH



NO. 2

NO. 1

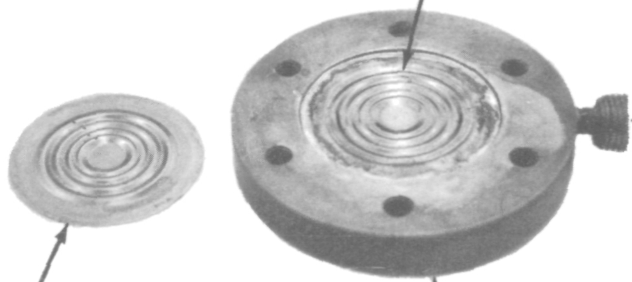
NO. 2

← TIME

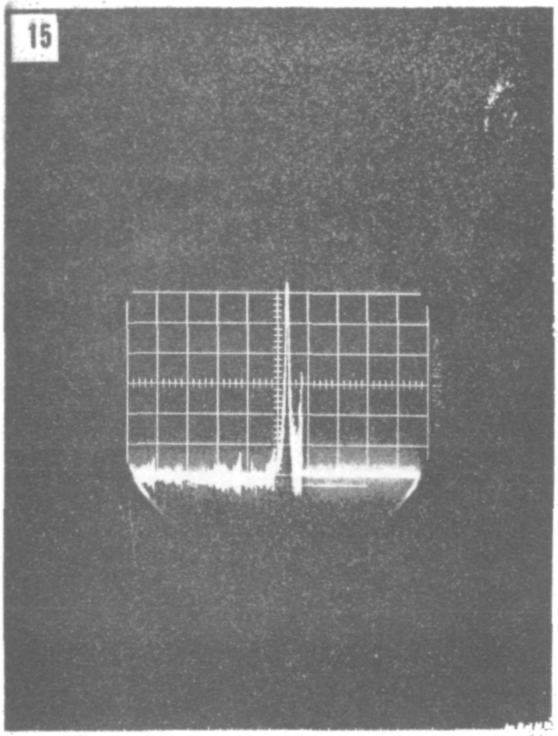
HORIZONTAL SCALE	1 MSEC PER DIVISION
VERTICAL SCALE	10 VOLTS PER DIVISION
CIRCUIT POTENTIAL	31 VDC
CIRCUIT CURRENT	3 AMPERES

TRANSFER TIME, LIFE CYCLE TEST, 10600 CYCLES, 45 PSIA
PROTOTYPE PRESSURE SWITCH

14



TEST FIXTURE FOR CYCLING .001'' CALIBRATION DIAPHRAGM (cover removed)



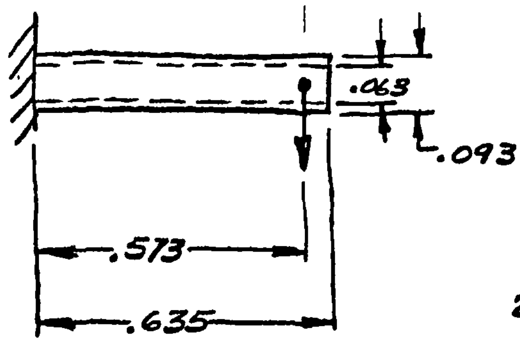
SHOCK TEST

HORIZONTAL SCALE	10 MSEC PER DIVISION
VERTICAL SCALE	100 G's PER DIVISION
DROP HEIGHT	54-1/2"

SHOCK TEST, ALNICO 5 MAGNET MATERIAL

DETERMINE THE NATURAL FREQ. OF THE LINKAGE ASSY. IN THE FREE CONDITION.

ASSUME CONTACT END OF BEAM IS FIXED @ PIVOT WITH UNIFORM LOAD OVER ENTIRE LENGTH WITH A CONCENTRATED LOAD DUE TO SILVER CONTACT MAT'L.



ω_1 = RAD/SEC DUE TO UNIFORM LOAD

ω_2 = RAD/SEC DUE TO CONCENTRATED LOAD

$$2\pi f = \left[\frac{\omega_1^2 \omega_2^2}{\omega_1^2 + \omega_2^2}\right]^{\frac{1}{2}}$$

UNIFORM LOAD

$$\omega_1 = \frac{3.52}{l^2}\left[\frac{EI}{m}\right]^{\frac{1}{2}}$$

$E = 30 \times 10^6$ psi

$l^2 = .635^2 = .404$

$$m = .785\left[(9.3\times10^{-2})^2 - (6.3\times10^{-2})^2\right]\frac{.284}{386}$$

$$m = .785\left(\overset{46.9\times10^{-4}}{86.5\times10^{-4} - 39.6\times10^{-4}}\right)7.35\times10^{-4}$$

$$m = 271\times10^{-8}\ \frac{\#\ sec^2}{in^2}$$

$$I = \frac{\pi}{64}(D^4 - d^4) = .49\left(7.8\times10^{-5} - 1.58\times10^{-5}\right)$$

$$I = .49\left(6.22\times10^{-5}\right) = 3.05\times10^{-5}\ in^4$$

$$\omega_1 = \frac{3.52}{.404}\left[\frac{30\times10^6\,(3.05\times10^{-5})}{2.71\times10^{-8}}\right]^{\frac{1}{2}} \qquad 3.375\times10^{8}$$

$$\omega_1 = 8.73 \cdot \left(1.838\times10^4\right) = 16.02\times10^4 \text{ RAD/SEC} \qquad f = 2.55\times10^4$$

$$\omega_1^2 = 257\times10^8$$

CONCENTRATED LOAD

$$\omega_2 = \left(\frac{3EI}{M\ell^3}\right)^{\frac{1}{2}} \qquad M = \frac{43.9\times10^{-6}}{386} = 11.36\times10^{-8}\ \frac{\#\,sec^2}{in}$$

$$\omega_2 = \left[\frac{3\left(30\times10^6\right)3.05\times10^{-5}}{11.36\times10^{-8}(.188)}\right]^{\frac{1}{2}} \qquad \ell^3 = .573^3 = .188 \text{ in}^3$$

$$f = .571\times10^5$$

$$\omega_2 = \left(12.85\times10^{10}\right)^{\frac{1}{2}} = 3.585\times10^5 \text{ RAD/SEC}$$

$$\omega_2^2 = 12.85\times10^{10}$$

$$\omega = \sqrt{\frac{(2.57\times10^{10})(12.85\times10^{10})}{15.42\times10^{10}}} = \sqrt{\frac{33\times10^{20}}{15.42\times10^{10}}}$$

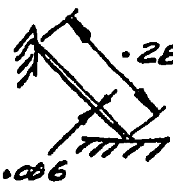
$$\omega = \sqrt{2.14\times10^{10}} = \omega = 1.46\times10^5 \qquad {}^*\omega_c^2 = 2.14\times10^{10}$$

$$f = .232\times10^5 = \underline{\underline{23{,}200}} \text{ CPS}$$

FOR CONTACT END OF BEAM

PIVOT, LEG

ASSUME EACH LEG OF PIVOT IS BEAM FIXED AT EACH END



$E = 28 \times 10^6$ psi

$I_{LEG} = \frac{b H^3}{12}$

$I = \frac{.1\,(216 \times 10^{-9})}{12}$

$I = 1.8 \times 10^{-9}$ in^4

$m = \frac{.006\,(.1)(.290)}{386}$

$m = 4.51 \times 10^{-7}$ $\frac{\# \sec^2}{in^2}$

$l^2 = .281^2 = .079 = 7.9 \times 10^{-2}$

UNIFORM LOAD

$$\omega_1 = \frac{22.4}{l^2}\left[\frac{EI}{m}\right]^{\frac{1}{2}}$$

$$\omega_1 = \frac{22.4}{7.9 \times 10^{-2}}\left[\frac{28 \times 10^6\,(1.8 \times 10^{-9})}{4.51 \times 10^{-7}}\right]^{\frac{1}{2}}$$

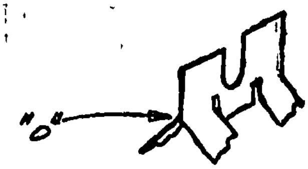
$$\omega_1 = 2.83 \times 10^2\,(11.16 \times 10^4)^{\frac{1}{2}}$$

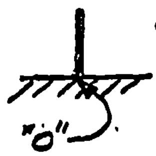
$$\omega_1 = 2.83 \times 10^2\,(3.34 \times 10^2) = 9.46 \times 10^4 \text{ RAD/SEC}$$

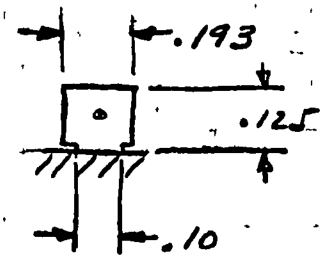
$\omega_1^2 = 89.5 \times 10^8$

$f = 1.505 \times 10^4 = \underline{\underline{15,050 \text{ CPS}}}$

PIVOT, BEAM JUNCTURE







CONCENTRATED LOAD

$$I = \frac{.1\,(\overset{1.728\times10^{-6}}{.012})^3}{12} = 1.439\times10^{-8}\ \text{in}^4$$

$$\omega_1 = \left(\frac{3EI}{Ml^3}\right)^{\frac{1}{2}}$$

$$E = 27\times10^6$$

$$\omega_1 = \left[\frac{\overset{1163\times10^{-8}}{3(27\times10^6)(1.439\times10^{-8})}}{\underset{533\times10^{-13}}{(2.13\times10^{-7})(250\times10^{-6})}}\right]^{\frac{1}{2}}$$

$$M = \frac{.193\,(.012)(.125)(.284)}{386}$$

$$M = 2.13\times10^{-7}\ \frac{\#\ \text{sec}^2}{\text{in}}$$

$$\omega_1 = \left(2.183\times10^{10}\right)^{\frac{1}{2}}$$

$$l^3 = \left(6.3\times10^{-2}\right)^3 = 250\times10^{-6}\ \text{in}^3$$

$\omega_1 = 1.476\times10^5$ RAD/SEC $\quad f = .235\times10^5 = \underline{23500}$ CPS

$$\omega_1^2 = 2.183\times10^{10}$$

PIVOT ω_1^2 LEG & ω_1^2 BEAM JUNCTURE

$$\omega = \sqrt{\frac{(89.5 \times 10^8)(218.3 \times 10^8)}{307.8 \times 10^8}}$$

$$\omega = (63.5 \times 10^8)^{\frac{1}{2}} = 7.96 \times 10^4$$

$^*\omega_p^2 = 63.5 \times 10^8$

$f_{PIVOT} = \underline{12,690}$ cps

DIAPHRAGM

SHELL = .006" THK

SPRING RATE = 560 #/in

EFFECTIVE AREA = .331 in^2

$W = .331(.006)(.294)$

$W = 58.5 \times 10^{-5}$ #

$$\omega = \sqrt{\frac{Kg}{W}} = \sqrt{\frac{560(386)}{58.5 \times 10^{-5}}}$$

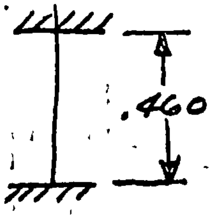
$$\omega = \sqrt{369.5 \times 10^6}$$

$$\omega = 19.2 \times 10^3$$

* $\omega_s^2 = 369.5 \times 10^6$

$$f = 3.060 \times 10^3 = \underline{\underline{3060}} \text{ cps}$$

LINK



.500

$$E = 27 \times 10^{6}$$

$$m = \frac{.125(.010)(.294)}{386}$$

$$m = .951 \times 10^{-6} \ \frac{\# \sec^2}{in^2}$$

$$\omega = \frac{22.4}{.25}\left[\frac{27\times10^{6}\,(1.04\times10^{-8})}{.951\times10^{-6}}\right]^{\frac{1}{2}} \qquad l^2 = .5^2 = .25 \text{ in}^2$$

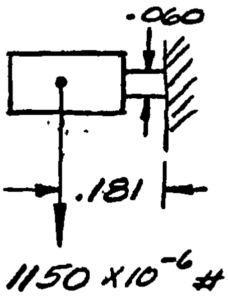
$$\omega = 89.5\left(295\times10^{4}\right)^{\frac{1}{2}} \qquad I = \frac{.125(.010)^3}{12} = 1.04\times10^{-8} \text{ in}^4$$

$$\omega = 89.5\left(17.18\times10^{2}\right)$$

$$\omega = 1538\times10^{2} \qquad f = \underline{24{,}500 \text{ cps}}$$

$$^{*}\ \omega_L^2 = 236\times10^{8}$$

BEAM, C'BAL END



$E = 28 \times 10^6$

$I = \frac{\pi D^4}{64} = \frac{3.14\,(.060)^4}{64}$ 12.96×10^{-6}

$I = .635 \times 10^{-6}$

UNIFORM LOAD

$\omega_1 = \frac{3.52}{l^2}\left(\frac{EI}{m}\right)^{\frac{1}{2}}$

$m = \frac{.785\,(6 \times 10^{-2})^2\,.28}{386}$ 36×10^{-4}

$\omega_1 = 37.6\left[\frac{(28\times10^6)(.635\times10^{-6})}{2.05\times10^{-6}}\right]^{\frac{1}{2}}$ 8.67×10^6

$m = 2.05 \times 10^{-6}\ \frac{\#\ sec^2}{in^2}$

$l^2 = (.306)^2 = 9.36 \times 10^{-2}$

$\omega_1 = 37.6\,(2.94 \times 10^3) = 1107 \times 10^3$ $f = 17.6 \times 10^3$ CPS

$\omega_1^2 = 122 \times 10^8$ RAD/SEC

CONCENTRATED LOAD

$\omega_2 = \left(\frac{3EI}{Ml^3}\right)^{\frac{1}{2}}$

$l^3 = (.181) = 5.93 \times 10^{-3}$

$\omega_2 = \left[\frac{3(28\times10^6)(.635\times10^{-6})}{(2.98\times10^{-6})(5.93\times10^{-3})}\right]^{\frac{1}{2}}$

$M = \frac{1150 \times 10^{-6}}{386} = 2.98 \times 10^{-6}\ \frac{\#\ sec^2}{in}$

$\omega_2 = (3.02 \times 10^9)^{\frac{1}{2}}$

$\omega_2 = 5.47 \times 10^4$ RAD/SEC $f = .872 \times 10^4$

$\omega_2^2 = 3.02 \times 10^9$

BEAM ℄'BAL END (CONTINUED)

$$\omega = \sqrt{\frac{(12.2\times10^9)^2(3.02\times10^9)^2}{15.22\times10^9}}$$

$$\omega = \sqrt{2.42\times10^9}$$

$$\omega = 4.91\times10^4$$

$$^{*}\omega_{CB}^2 = 2.42\times10^9$$

$$f = .782\times10^4 = \underline{\underline{7820}}\ \text{cps}$$

COMBINING THE FREQUENCIES OF THE INDIVIDUAL COMPONENTS $\omega = \sqrt{\dfrac{\omega_1^2 \omega_2^2}{\omega_1^2 + \omega_2^2}}$

$\omega_c^2 = 2.14 \times 10^{10}$

$\omega_p^2 = \dfrac{.635 \times 10^{10}}{2.775}$

$$\omega = \sqrt{\frac{2.14 \times 10^{10} (.635 \times 10^{10})}{2.775 \times 10^{10}}} = \sqrt{.494 \times 10^{10}}$$

$\omega = .702 \times 10^5$ $\qquad f = 11180$ CPS

* $\omega^2_{P \& C} = .494 \times 10^{10}$

$\omega_D^2 = .037 \times 10^{10}$

$\omega_L^2 = \dfrac{2.36 \times 10^{10}}{2.397 \times 10^{10}}$

$$\omega = \sqrt{\frac{.037 \times 10^{10} (2.36 \times 10^{10})}{2.397 \times 10^{10}}} = \sqrt{.364 \times 10^{8}}$$

$\omega = 1.905 \times 10^4$ $\qquad f = \underline{3036}$ CPS

* $\omega^2_{D \& L} = .0364 \times 10^{10}$

$$\omega_{CB}^2 = .242 \times 10^{10}$$

$$\omega_{P\&C}^2 = \frac{.494 \times 10^{10}}{.736}$$

$$\omega = \sqrt{\frac{.242 \times 10^{10} (.494 \times 10^{10})}{.736 \times 10^{10}}} = \sqrt{.162 \times 10^{10}}$$

$$\omega = .403 \times 10^5 \qquad f = \underline{6410} \text{ CPS}$$

$$* \ \omega_{P,C,CB}^2 = .162 \times 10^{10}$$

$$\omega_{P,C,CB}^2 = .162 \times 10^{10}$$

$$\omega_{D\&L}^2 = \frac{.0364 \times 10^{10}}{.1984}$$

$$\omega_{SYS} = \sqrt{\frac{16.2 \times 10^8 (3.64 \times 10^8)}{19.84 \times 10^8}} = \sqrt{2.973 \times 10^8}$$

$$\omega_{SYS.} = 1.725 \times 10^4 \qquad \frac{\omega}{2\pi} = f$$

$$f_N = \underline{\underline{2750}} \text{ CPS} \qquad \underline{\underline{\text{SYSTEM}}} \ \underline{\underline{\text{FREQUENCY}}}$$

CHECK

THE FUNDAMENTAL NATURAL FREQUENCY OF THE COMBINED SYSTEM USING DUNKERLEYS GENERAL EQUATION:

$$\frac{1}{\omega^2} = \frac{1}{\omega_1^2} + \frac{1}{\omega_2^2} + \cdots \frac{1}{\omega_N^2}$$

FOR THE LINKAGE SYSTEM OF DIAPHRAGM, LINK PIVOT & BEAM THE ABOVE EQUATION BECOMES

$$\omega^2 = \frac{\overbrace{\omega_1^2\omega_2^2\omega_3^2\omega_4^2\omega_5^2}^{1}}{\underbrace{\omega_2^2\omega_3^2\omega_4^2\omega_5^2}_{2} + \underbrace{\omega_1^2\omega_3^2\omega_4^2\omega_5^2}_{3} + \underbrace{\omega_1^2\omega_2^2\omega_4^2\omega_5^2}_{4} + \underbrace{\omega_1^2\omega_2^2\omega_3^2\omega_5^2}_{5} + \underbrace{\omega_1^2\omega_2^2\omega_3^2\omega_4^2}_{6}}$$

ω = SYSTEM FREQ.

$\omega_1^2 = \omega_c^2 = 2.14\times10^{10}$

$\omega_2^2 = \omega_p^2 = .635\times10^{10}$

$\omega_3^2 = \omega_D^2 = .03695\times10^{10}$

$\omega_4^2 = \omega_L^2 = 2.36\times10^{10}$

$\omega_5^2 = \omega_{CB}^2 = .242\times10^{10}$

1 $= 2.865\times10^{48}$

2 $= 1.34\times10^{38}$

3 $= 4.52\times10^{38}$

4 $= 77.6\times10^{38}$

5 $= 1.216\times10^{38}$

6 $= 11.85\times10^{38}$

$$\omega^2 = \frac{2.865\times10^{48}}{1.34\times10^{38} + 4.52\times10^{38} + 77.6\times10^{38} + 1.216\times10^{38} + 11.85\times10^{38}}$$

$$\omega^2 = \frac{2.865 \times 10^{48}}{.96526 \times 10^{40}}$$

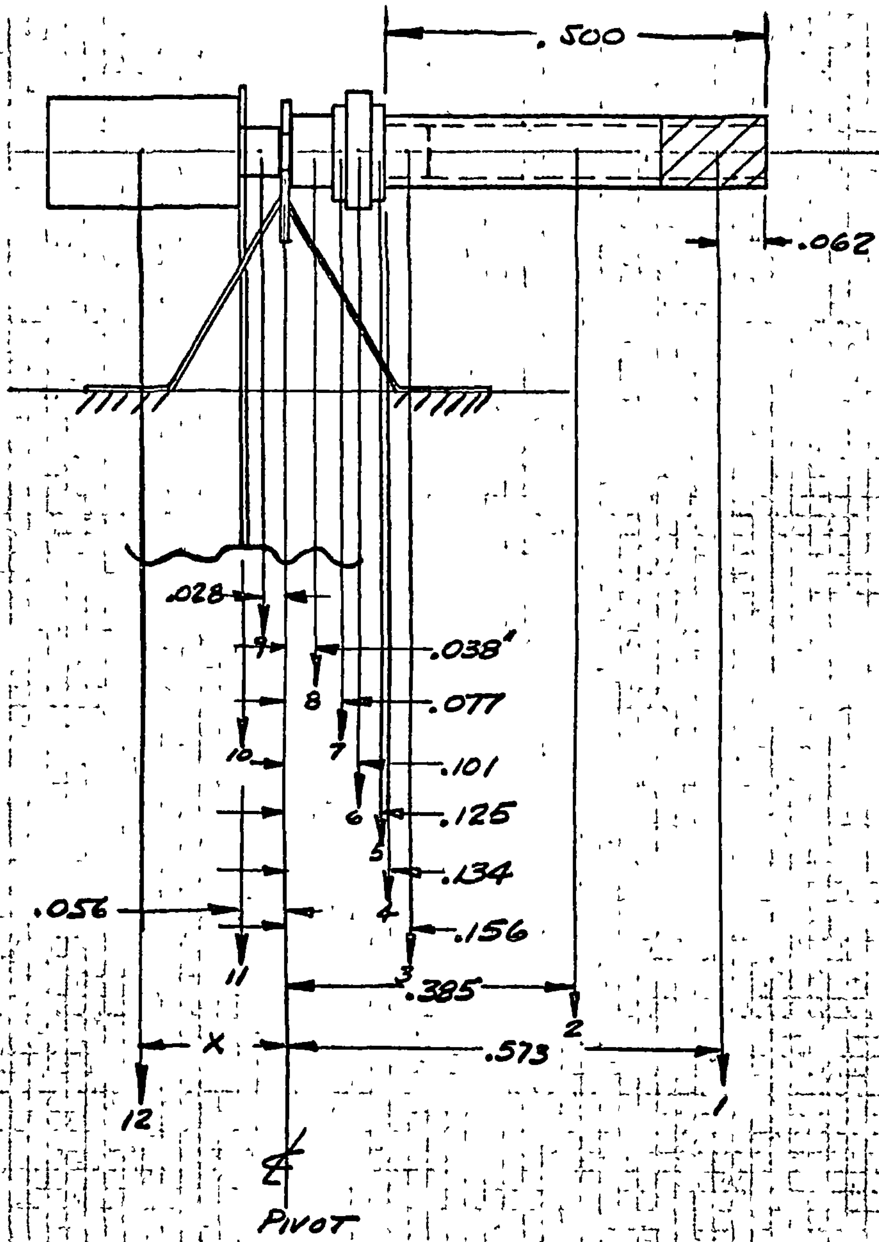
$$\omega^2 = 2.97 \times 10^8$$

$$\omega = 1.724 \times 10^4 \text{ RAD/SEC}$$

$$f = \frac{\omega}{2\pi} = \frac{1.724}{6.28} \times 10^4 = .275 \times 10^4 = \underline{\underline{2750}} \text{ CPS}$$

MASS BALANCE—SYSTEM LINKAGE

INCL. BEAM, PIVOT, INSULATOR, TERMINAL LEAF, LINK DIAPHRAGM, & COUNTERBALANCE



MASS BALANCE – (CONTINUED)

COMPONENT WEIGHTS

1. SILVER CONTACT

$3.14(.0943)(.0025)(.156)(.38\ \#/in^3) =$ ———— $43.9\times10^{-6}\ \#$

2. BEAM, COMMON CONTACT

$.785\left[(9.3\times10^{-2})^2 - (6.2\times10^{-2})^2\right](.5)(.284)$ (86.5×10^{-4}, 38.5×10^{-4})

$.785(48\times10^{-4})(.142) =$ ———— $535\times10^{-6}\ \#$

3. STUD

$.785(2.9\times10^{-2})^2(.046)(.284) =$ (8.4×10^{-4}) ———— $8.64\times10^{-6}\ \#$

4. TERMINAL LEAF

$.0015(.093)(.297)(.305) =$ ———— $12.65\times10^{-6}\ \#$

5. DISC

$.785(.125)^2(.016)(.284) = 55.6\times10^{-6} + 5\%$ FOR SOLDER ($.0156$) $58.4\times10^{-6}\ \#$

6. INSULATOR, CERAMIC

70.5×10^{-6} + SOLDER 5% = ———— $73.5\times10^{-6}\ \#$

7. = 5 ———— $58.4\times10^{-6}\ \#$

8. ROD, CONTACT SIDE OF PIVOT

$.785(9.3\times10^{-2})^2(.062)(.284) =$ (86.5×10^{-4}) ———— $120\times10^{-6}\ \#$

9. ROD, LINK SIDE OF PIVOT

$.785(6.2\times10^{-2})^2(5.6\times10^{-2})(.284) =$ ———— $48.2\times10^{-6}\ \#$

MASS BALANCE – (CONTINUED)

COMPONENT WTS.

10. LINK

$\overset{LG}{.75}(.125)(.010)(.294)$ INCL. BRAZE = 276×10^{-6} #

11. DIAPHRAGM

$.006(.336)(.294) =$ 593×10^{-6} #

DETERMINE C'BAL WEIGHT & DISTANCE, X, TO SATISFY $\Sigma M_{PIVOT} = 0$

$43.9 \times 10^{-6}(.573) = 25.1 \times 10^{-6}$ #in

$535 \times 10^{-6}(.385 = 206.0 \times 10^{-6}$

$8.64 \times 10^{-6}(.156) = 1.35 \times 10^{-6}$

$12.65 \times 10^{-6}(.134) = 1.695 \times 10^{-6}$

$58.4 \times 10^{-6}(.125) = 7.25 \times 10^{-6}$

$73.5 \times 10^{-6}(.101) = 7.42 \times 10^{-6}$

$58.4 \times 10^{-6}(.077) = 4.5 \times 10^{-6}$

$120 \times 10^{-6}(.038) = 4.8 \times 10^{-6}$

258.115×10^{-6} #in

$48.2 \times 10^{-6}(.028) = 1.35 \times 10^{-6}$ #in

$276 \times 10^{-6}(.056) = 15.45 \times 10^{-6}$ #in

$593 \times 10^{-6}(.056) = 33.20 \times 10^{-6}$ #in

50.00×10^{-6} #in

MASS BALANCE, (CONTINUED)

COUNTERBALANCE $(X) = (258.115 - 50)\ 10^{-6}$ #in

.125
.056

LET $X = .181$

$$C'BAL = \frac{208.115}{.181} \times 10^{-6}$$

$C'BAL = 1150 \times 10^{-6}$ # ∴ LENGTH OF C'BAL = .250"

DETERMINE D. OF C'BAL.

$$C'BAL.\ WT = .785\ D^2 (.250)(.284)$$

$$55.8 \times 10^{-3} D^2 = 1150 \times 10^{-6}$$

$$D^2 = \frac{1150 \times 10^{-6}}{55.8 \times 10^{-3}}$$

$$D^2 = 20.6 \times 10^{-3}$$

$D = 1.435 \times 10^{-1} = \underline{\underline{.144''}}$ DIA.

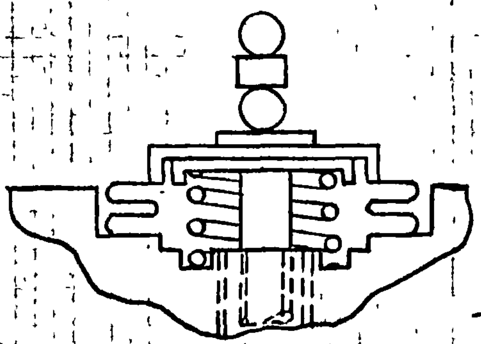
DATE 4/10/66

THE Bendix CORPORATION
FRIEZ INSTRUMENT DIVISION
BALTIMORE, MARYLAND 21204

ENGINEERING DEPARTMENT

ITEM

DETERMINE MAX. LOAD ON SETTING MECHANISM SPRING



	GMS
BELLOWS	= .5600
2 MAGNETS @ 2.0126 GMS	= 4.0252
INSULATOR	= .1160
INSULATOR	= .2100
SPRING	= 1.2700
DIFFERENTIAL SCR.	= 2.6200
COVER, BELLOWS	= 1.5800
ADJUSTING SCREW	= 1.8000
SOLDER (EST)	= .4000
	12.5812 gms

$\frac{12.581}{454} = .0277$ #

@ 30 G's FORCE ON SPRING = .831 #

SPRING, SETTING MECHANISM

SPACE AVAILABLE FOR SPRING WHEN THE BEAM IS IN THE NOMINAL OPERATING POSITION IS .215"

ALLOWING .040" FOR PRELOAD AND ADJUSTMENT IN THE UPWARD DIRECTION, THE FREE LENGTH IS .255"

ASSUMING 1.5 ACTIVE COILS (3.5 TOTAL COILS), THE SOLID HEIGHT IS .193"

DETERMINING THE NATURAL FREQUENCY OF THE SPRING:

M.E. HDBK
KENT'S 11-19

$$f_N = \frac{2d}{\pi D^2 N}\sqrt{\frac{G g}{32 \gamma}}$$

$N = 1.5$

$d = .055$

$I.D. = .312$

MEAN $DIA = .367 = D$

$O.D. = .422$

$$f_N = \frac{2(.055)}{3.14(.1345)(1.5)}\sqrt{\frac{10.5\times10^6(386)}{32\ (.29)}}$$

$d^3 = 1.66\times10^{-4}$

$d^4 = 9.15\times10^{-6}$

$D^2 = .1345$

$D^3 = 4.95\times10^{-2}$

$$f_N = .1738\sqrt{437\times10^6}$$

$$f_N = .1738\,(20.9\times10^3)$$

$$f_N = 3.63\times10^3 = \underline{\underline{3630}}\ CPS$$

SPRING, (CONTINUED)

$$K = \frac{Gd^4}{8D^3N} = \frac{10.5 \times 10^6 \; (9.15 \times 10^{-6})}{8 \; (4.95 \times 10^{-2}) \; 1.5}$$

$K = 161.5$ #/in

CHECK STRESS

@ .017" DEFLECTION $\quad P = .017 (161.5) = 2.745$ #

$$S = \frac{2.55 \; (2.745) \; .367}{1.66 \times 10^{-4}}$$

$S = 15{,}500$ psi

WAHL FACTOR = 1.22 $\quad S_c = \underline{\underline{18{,}900}}$ psi

@ .040" DEFLECTION $\quad P = .040 (161.5) = 6.46$ #

$$S = \frac{2.55 \; (6.46) \; .367}{1.66 \times 10^{-4}} = 36{,}400 \text{ psi}$$

$S_c = \underline{\underline{45{,}400}}$ psi

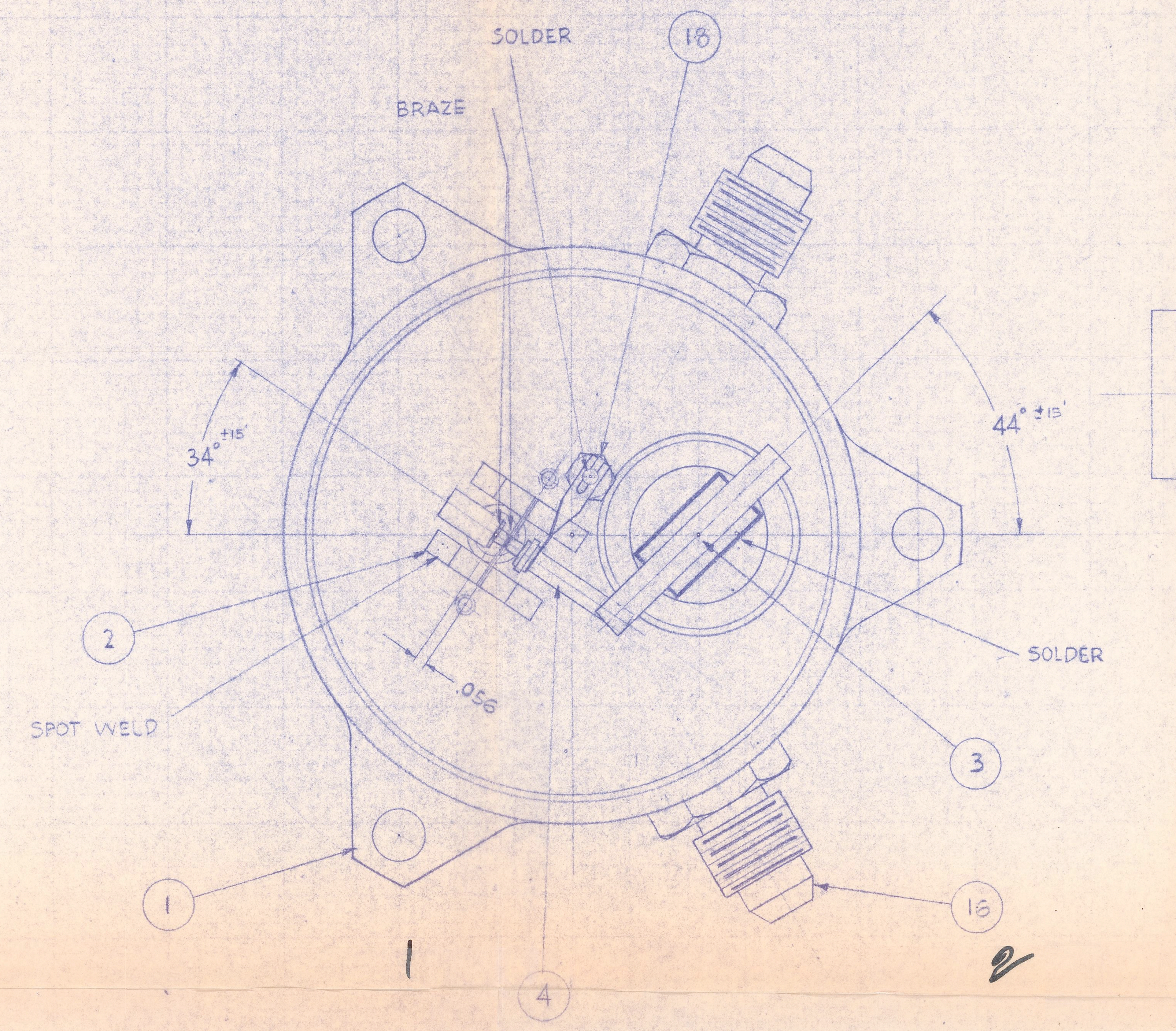
@ .062" DEFLECTION (SOLID HGT) $\quad P = .062 (161.5) = 10$ #

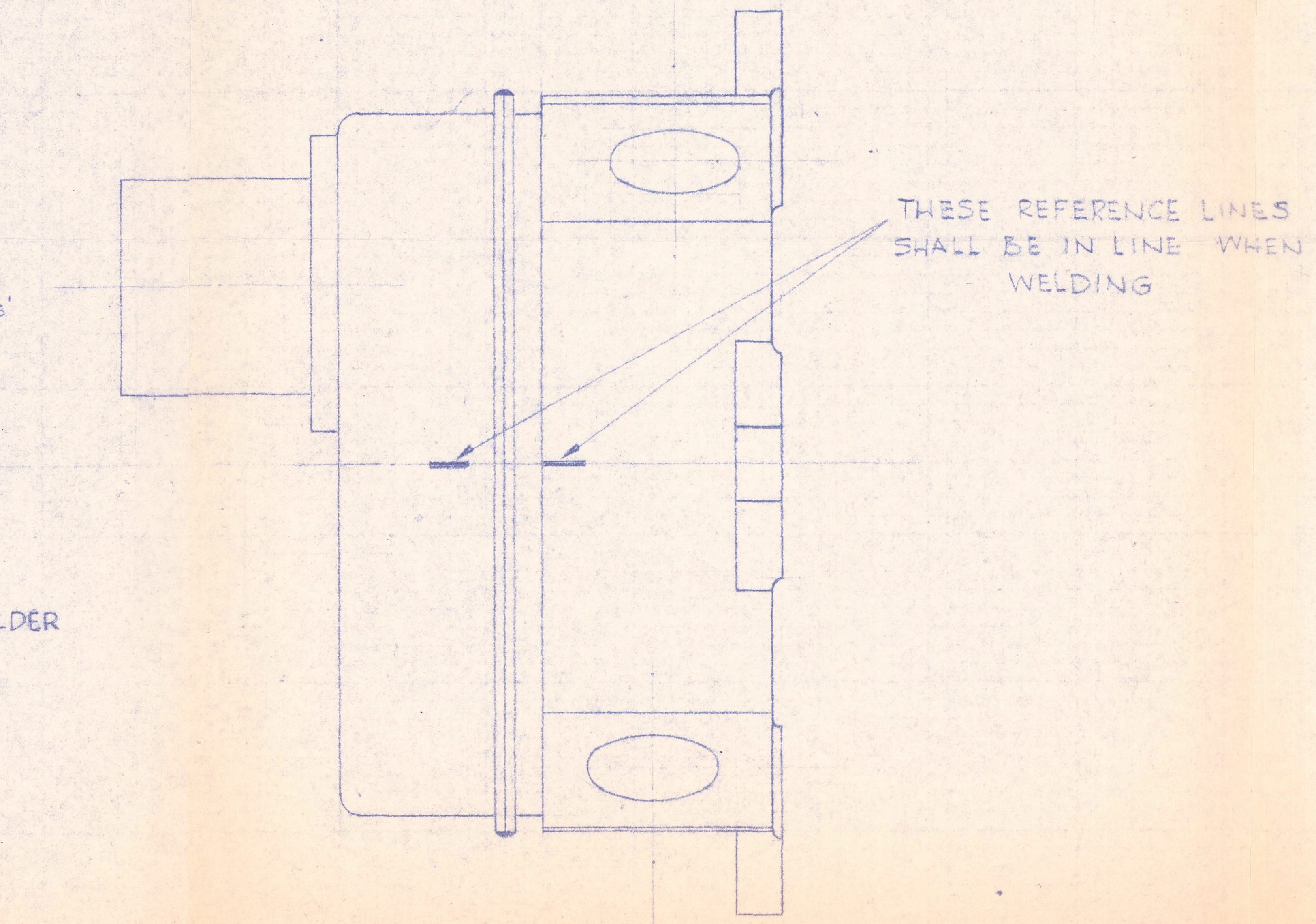
$$S = \frac{2.55 \; (10) \; .367}{1.66 \times 10^{-4}} = 56{,}400$$

$S_c = \underline{\underline{68{,}800}}$ psi

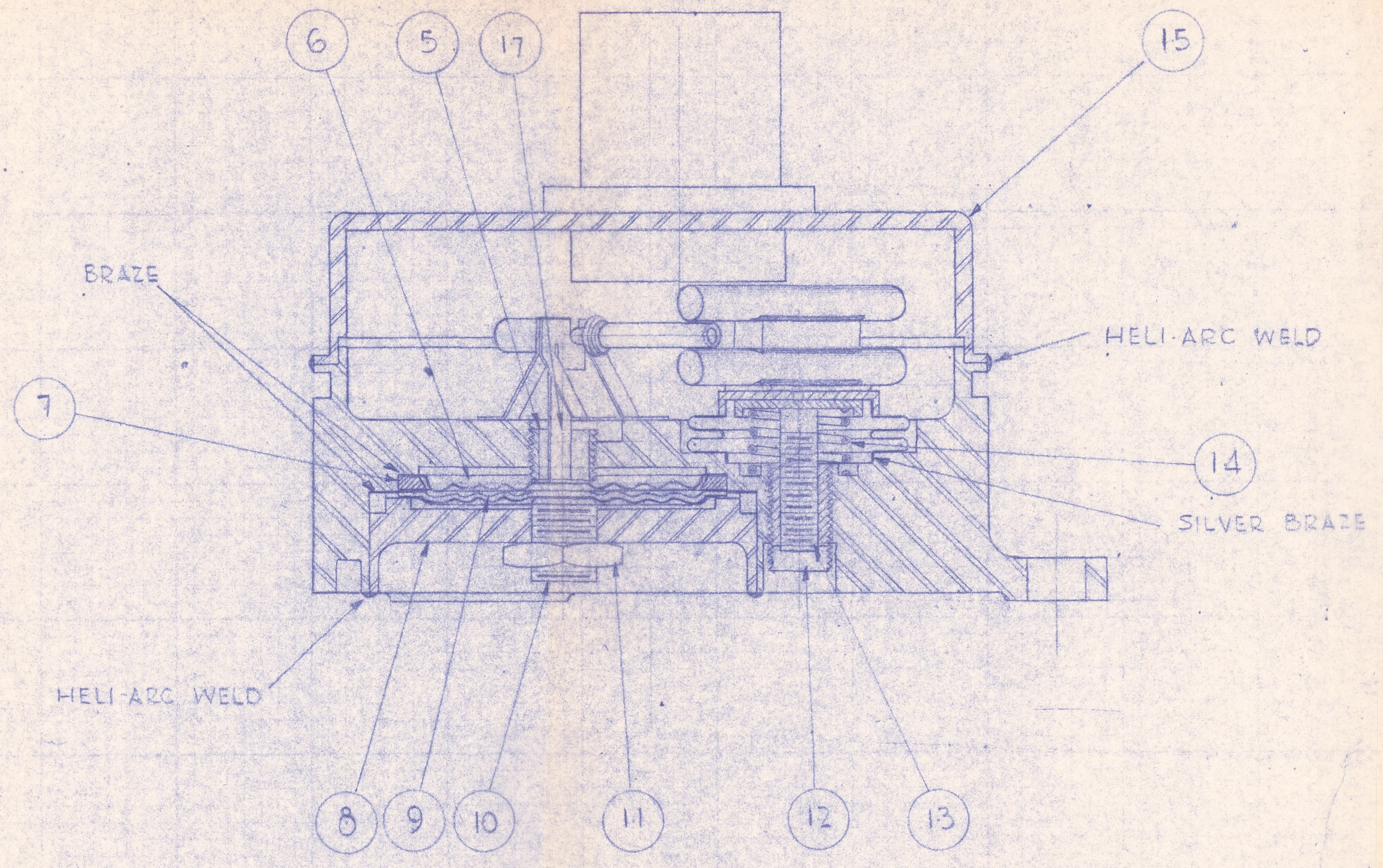
D. DRAWINGS AND SKETCHES

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B			





1 2 3 4



QTY REQD -1	ITEM NO.	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTES
1	18		1480-C	TERMINAL, INSULATED	USECO	
1	17	B	1149929-1	LINK, DIAPHRAGM		
2	16		4F5BX-S	FITTING, FLARE TUBE	PARKER	
1	15	B	1149954-1	COVER ASSEMBLY		
1	14	B	1149928	SPRING		
1	13	B	1149945	SCREW ASSEMBLY		
1	12	B	1149935	SCREW, DIFFERENTIAL		
1	11	B	1149927	NUT, HEX		
1	10	B	1149943-1	SCREW, CALIBRATION		
1	9	C	1149961	DIAPHRAGM, CALIBRATION		
1	8	B	1149957-1	PLATE ASSEMBLY DIAPHRAGM		
1	7	B	1149959	SPACER DIAPHRAGM		
1	6	C	1149951	DIAPHRAGM, SENSING		
1	5	B	1149956	STOP SCREW, DIAPHRAGM		
1	4	B	1149931-1	BEAM ASSEMBLY		
1	3	B	1149952-1	CONTACT ASSEMBLY		
2	2	B	1149932	PIVOT, FLEX		
1	1	D	1149962	HOUSING		

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES	DRAWN BY MARTIN — DATE 4-5-68	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204
	CHECKED BY — DATE	
	APPROVED BY — DATE	PRESSURE SWITCH ABSOLUTE TYPE
MATERIAL	CONTRACT NO.	
FINISH		SIZE D — CODE IDENT NO. 23667 — 1149999
		SCALE 2/1 — SHEET

5 6 7 8

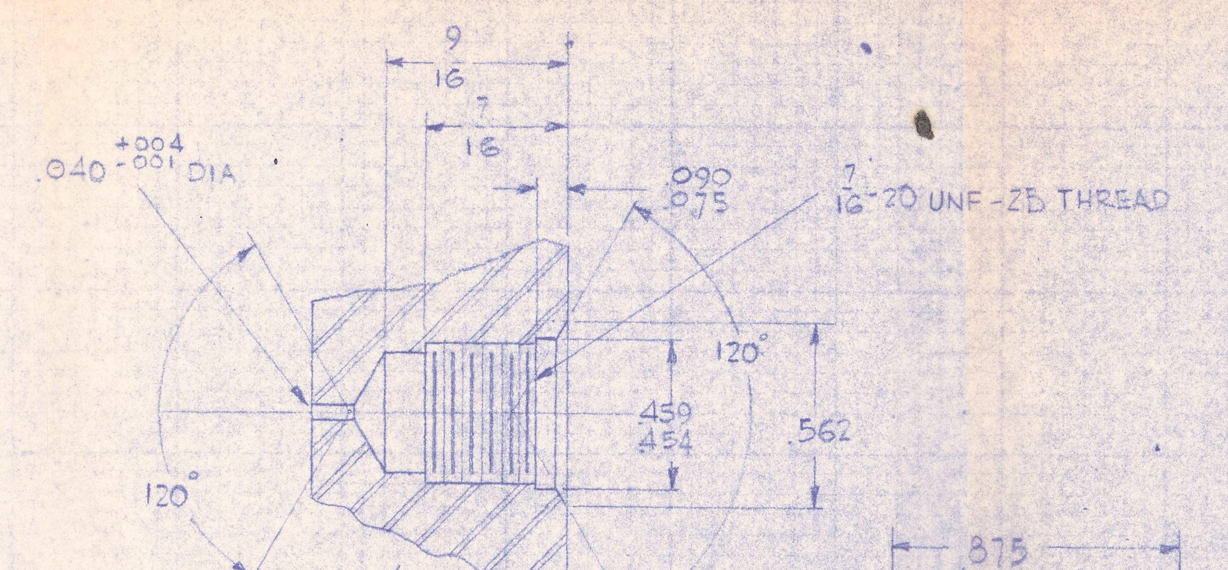
3024-065

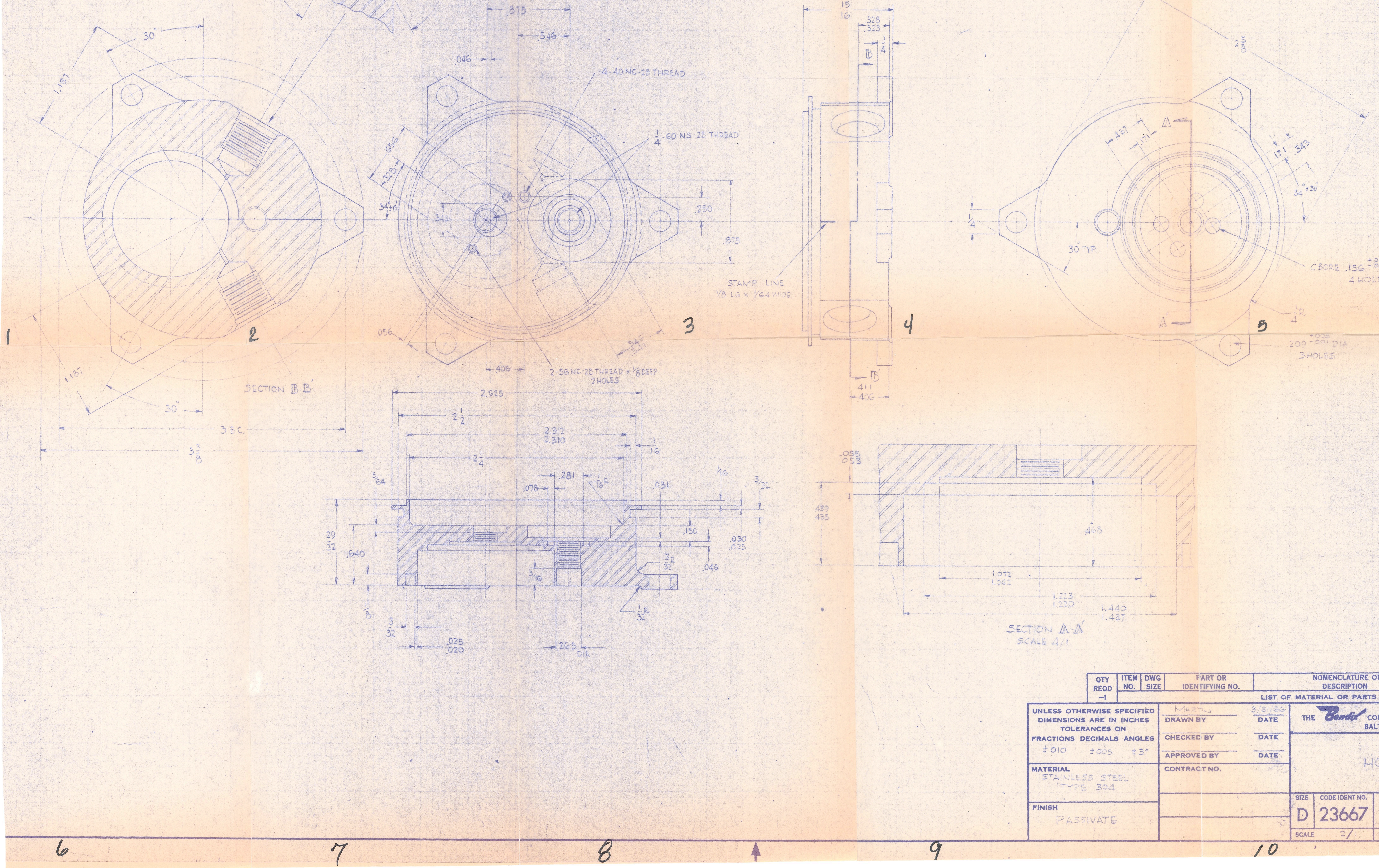
ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED

NOTES:

1 - INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL-D-70327.

2 - PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.





QTY REQD -1	ITEM NO.	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTES

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ±.010 DECIMALS ±.005 ANGLES ±3°

MATERIAL: STAINLESS STEEL TYPE 304

FINISH: PASSIVATE

DRAWN BY: Mattu DATE 3/8/66
CHECKED BY DATE
APPROVED BY DATE
CONTRACT NO.

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION
BALTIMORE, MARYLAND 21204

HOUSING

SIZE D | CODE IDENT NO. 23667 | 1149962

SCALE 2/1 | SHEET

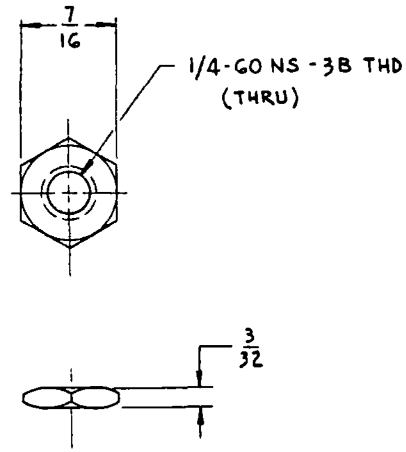
3024 95

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL
	A	NEW DRAWING	12-20 65	

NOTES.

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1					

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIM ARE IN INCHES. TOL ON FRACTIONS ±.010 DEC – ANGLES –	DRAWN BY J CONNELLY DATE 12-20-65	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204
MATERIAL STAINLESS STEEL TYPE 303	CHECKED BY DATE	NUT, HEX
FINISH PASSIVATE	APPROVED BY DATE	SIZE B · CODE IDENT NO 23667 · 1149927
	CONTRACT NO	SCALE 2/1 · SHEET 1 OF 1

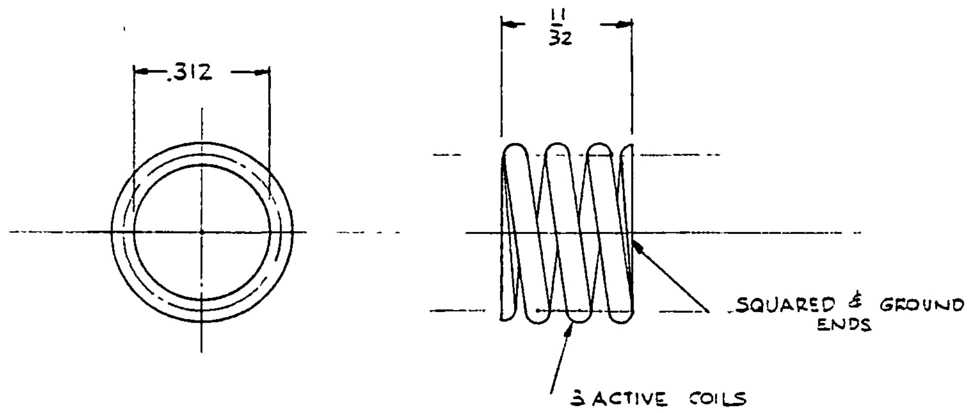
3024 053

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS ±.010 DEC ±.005 ANGLES —

MATERIAL: .051 CRES SPRING WIRE TYPE 302

FINISH

DRAWN BY: MARTIN DATE: 4-4-63

CHECKED BY — DATE

APPROVED BY — DATE

CONTRACT NO

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION
BALTIMORE, MARYLAND 21204

SPRING

SIZE	CODE IDENT NO	
B	23667	1149928

SCALE 4/1 SHEET

3629-B

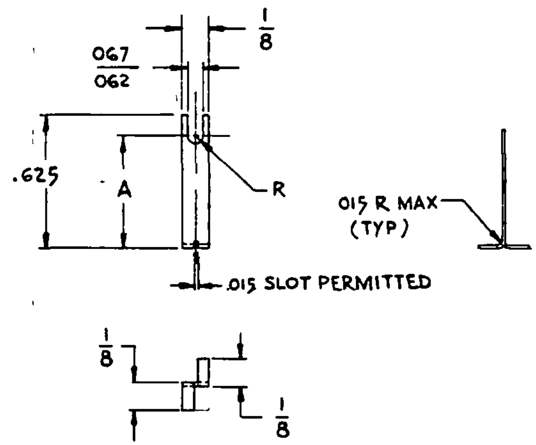
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL
	A	NEW DWG	12 17 65	
	B	MAT WAS ST ST		

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.

PART NO	DIM A
1149929-1	484
1149929 2	468



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1					

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS ±.010 DEC – ANGLES –	DRAWN BY J CONNELLY DATE	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204	
MATERIAL NI SPAN C .010 THICK	CHECKED BY DATE	LINK, DIAPHRAGM	
	APPROVED BY DATE		
	CONTRACT NO.		
FINISH		SIZE B	CODE IDENT NO. 23667 — 1149929
		SCALE 2/1	SHEET 1 OF 1

3024-047

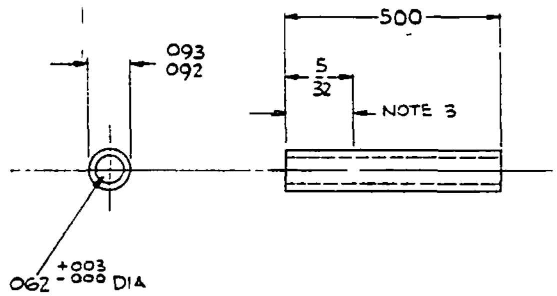
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.

3 SILVER PLATE 0025 TO 0030 THICK TO DIMENSION SHOWN



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
-1					

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS ±010 DEC ±005 ANGLES -

MATERIAL: ARMCO PURE IRON

FINISH

DRAWN BY: MARTIN DATE: 3-31-66

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION
BALTIMORE MARYLAND 21204

CONTACT

SIZE: B CODE IDENT NO: 23667 1149930

SCALE 4/1 SHEET

302401

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

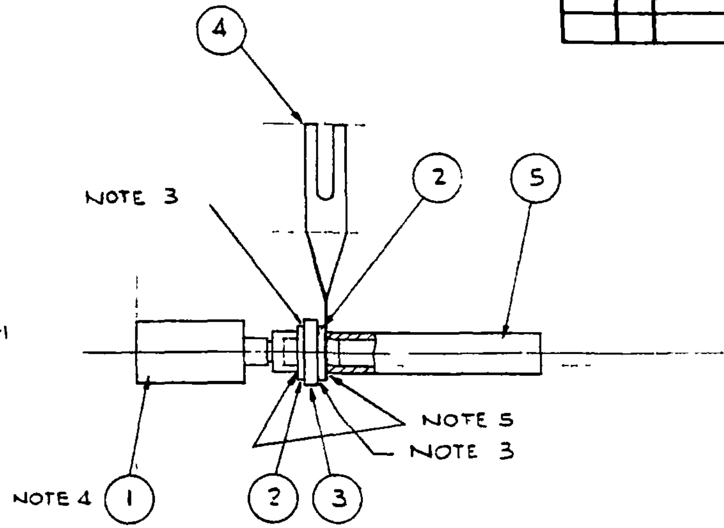
1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING

3 BRAZE ITEMS 2 & 3 TOGETHER AS A UNIT BEFORE COMPLETELY ASSEMBLING BEAM

4 BRAZE ITEM 1 TO DIAPHRAGM LINK & FLEX PIVOT (ASSEM 3024-065) & D1149923-1

5 SOLDER THESE JOINTS AT FINAL ASSEMBLY OF BEAM ON 3024-065 & D1149923-1



QTY REQD	ITEM NO.	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
1	5	B	1149930	CONTACT	
1	4	B	1149937	LEAF TERMINAL	
1	3			CERAMIC DISC	
2	2	B	1149942	BUSHING BEAM	
1	1	B	1149940	COUNTER-BALANCE, BEAM	
-1			LIST OF MATERIAL OR PARTS LIST		

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS DEC ANGLES

MATERIAL

FINISH

DRAWN BY MARTIN DATE 4-1-66

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204

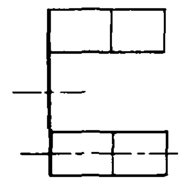
BEAM ASSEMBLY

SIZE B | CODE IDENT NO 23667 | 1149931

SCALE 4/1 | SHEET

3921-10

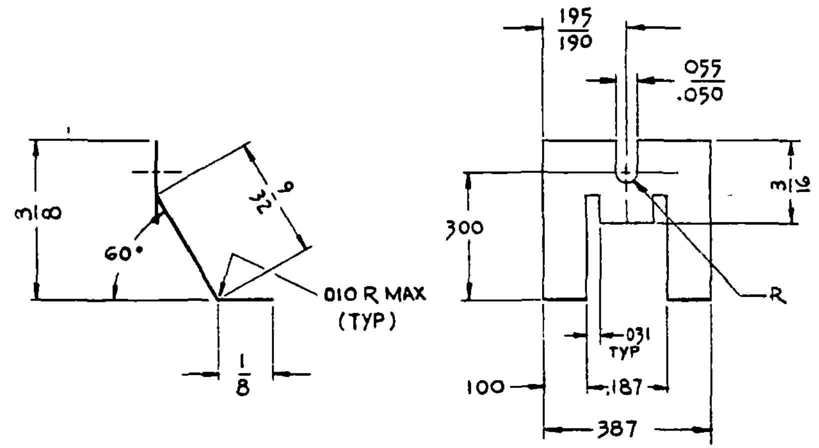
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL
	A	NEW DRAWING	12 20 65	
	B	WAS TYPE 304 ST.ST		



NOTES.

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO.	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS ±.010 DEC ±.005 ANGLES ±2°

MATERIAL .006 THK STAINLESS STEEL TYPE 302 SPRING TEMP

FINISH PASSIVATE

J CONNELLY 12-20-65
DRAWN BY DATE

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION
BALTIMORE, MARYLAND 21204

PIVOT, FLEX

SIZE	CODE IDENT NO	
B	23667	1149932

SCALE 4/1 SHEET 1 OF 1

3021 023

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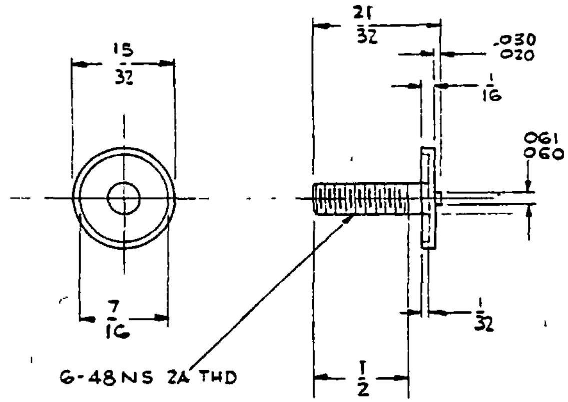
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS ±.010 DEC ±.005 ANGLES -

MATERIAL STAINLESS STEEL TYPE 304

FINISH PASSIVATE

DRAWN BY MARTIN DATE 3-31-66

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204

SCREW, CENTER

SIZE B CODE IDENT NO. 23667 1149933

SCALE 2/1 SHEET

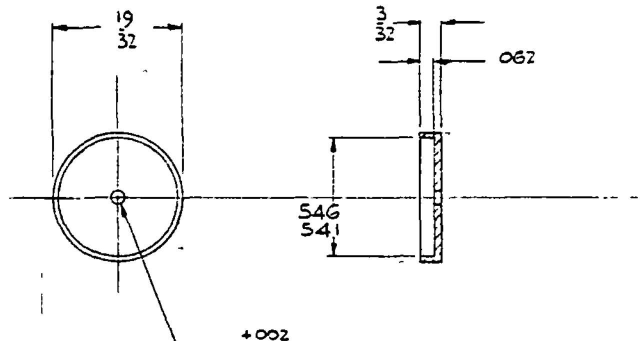
3024-08

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS ±010 DEC ±005 ANGLES -	DRAWN BY MARTIN DATE 3 31 63	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204
MATERIAL BRASS	CHECKED BY DATE	CAP, SCREW
	APPROVED BY DATE	
	CONTRACT NO	
FINISH		SIZE B CODE IDENT NO 23667 1149934
		SCALE 2/1 SHEET

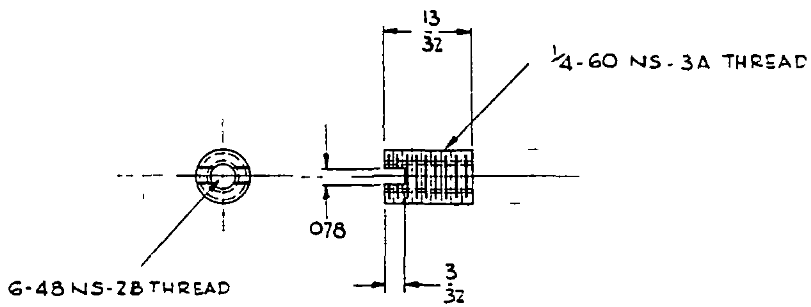
3024 09

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1					

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL. ON FRACTIONS DEC ANGLES
±.010 ±.005 –

MATERIAL: ALUM BRONZE GRADE 13

FINISH

DRAWN BY: MARTIN DATE: 3 31 56

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION
BALTIMORE, MARYLAND 21204

SCREW DIFFERENTIAL

SIZE: B | CODE IDENT NO. 23667 | 1149935

SCALE 2/1 | SHEET

3024-12

ZONE	LTR	DESCRIPTION	DATE	APPROVAL
REVISIONS				
	A	NEW DRAWING	1-17 66	
	B	NOTE 5 - .0001-.0002 THK TO .0005 MIN.	2 15 66	
	C	NOTE 5 .0005 TO .0003, -1,-2 DIM CHG'D	3-25 66	

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.

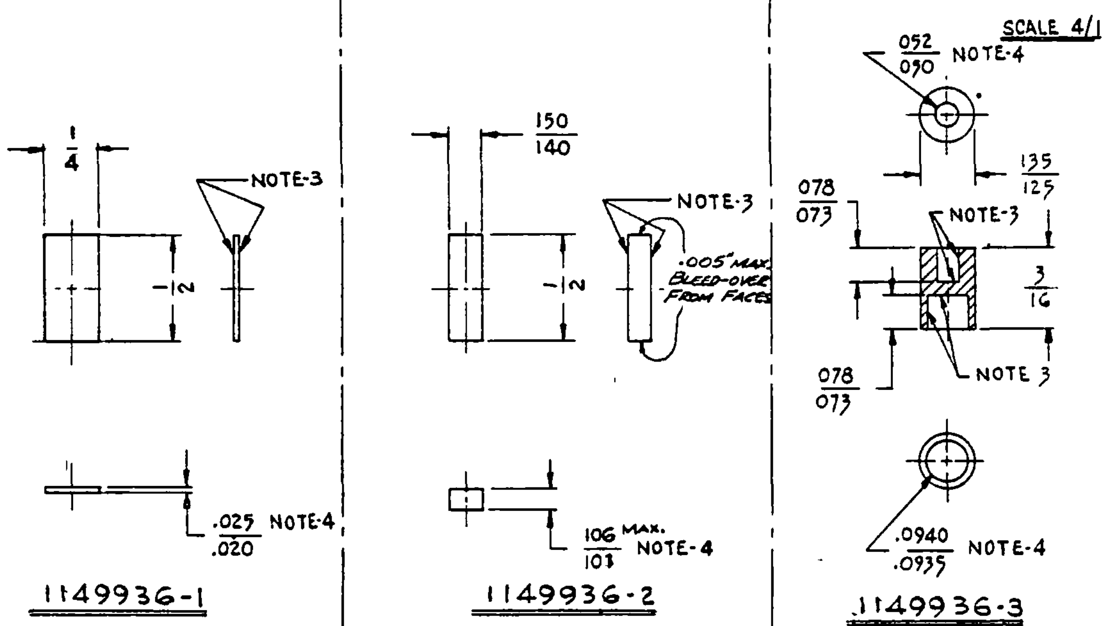
3- ENTIRE SURFACE INDICATED TO BE METALIZED FOR BRAZING IN NEXT ASS'Y

4- OVERALL DIMENSIONS INDICATED ARE TO INCLUDE METALIZED THICKNESSES

5- MATERIAL - CERAMIC AL_2O_3 PREFERRED. METALIZED AREAS - Cu PLATED .0003 MIN. THK

6- INSULATOR TO BE CAPABLE OF BEING SILVER SOLDERED @ 1300 TO 1400°F USING ASTM B260 BAg 7 ALLOY ON TO ALNICO No 5 MATERIAL. BRAZING TO BE DONE IN A HYDROGEN BELT FURNACE. METALIZING MUST NOT SEPARATE FROM CERAMIC.

7 ELECTRICAL:
DIELECTRICAL STRENGTH, 100 VDC/MIL MINIMUM IN AIR ATMOSPHERE, MEAN SEA LEVEL TO 100,000 FT.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
-1					

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL. ON FRACTIONS ±.010 DEC — ANGLES —

MATERIAL NOTE - 5

FINISH

DRAWN BY J CONNELLY DATE 1/17/66

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO.

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204

INSULATORS

SIZE B | CODE IDENT NO. 23667 | 1149936

SCALE 2/1 | SHEET 1 OF 1

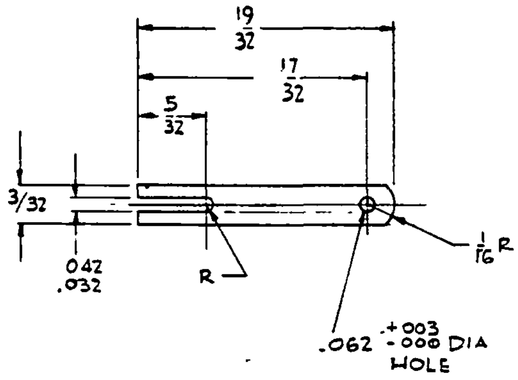
3024-066

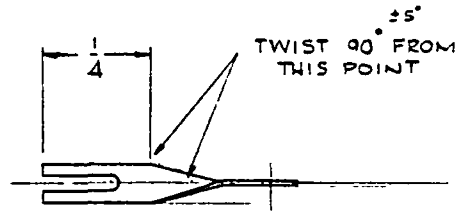
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY NO. 0-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.





AFTER FORMING

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QTY REQD	ITEM NO.	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS DEC ANGLES ±010 ±005

MATERIAL .002 BERYLLIUM COPPER 1/2 HARD

FINISH

DRAWN BY MARTIN DATE 4 1 62

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204

LEAF, TERMINAL

SIZE B CODE IDENT NO. 23667 1149937

SCALE 4/1 SHEET

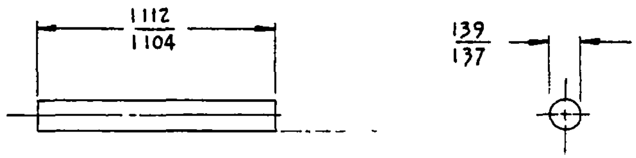
3024-13

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL
	A	NEW DWG	12 27 65	

NOTES.

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1					

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS – DEC – ANGLES –	DRAWN BY J CONNELLY DATE 12 27 65 CHECKED BY DATE APPROVED BY DATE CONTRACT NO	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204
MATERIAL ALNICO Nº 5		MAGNET
FINISH		SIZE B · CODE IDENT NO 23667 · 1149939
		SCALE 2 / 1 · SHEET 1 OF 1

3024-062

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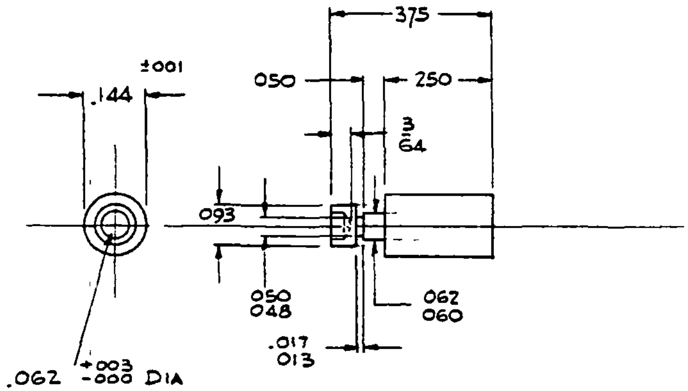
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY NO. D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
-1					

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL. ON FRACTIONS ±010 DEC ±005 ANGLES -

MATERIAL STAINLESS STEEL TYPE 303

FINISH PASSIVATE

DRAWN BY MARTIN DATE 4 6 66

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION
BALTIMORE, MARYLAND 21204

COUNTER-BALANCE, BEAM

SIZE B | CODE IDENT NO. 23667 | 1149940

SCALE 4/1 | SHEET

3024 15

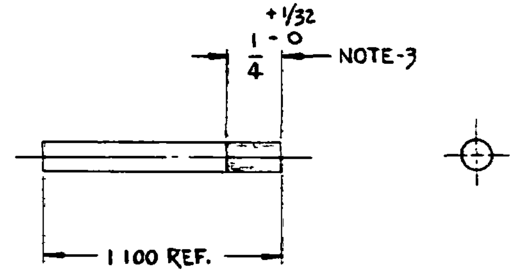
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL
	A	NEW DWG	12 27 65	

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY NO. D-70327.

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.

3- SILVER PLATE .0018 TO .0023 THICK TO DIMENSION SHOWN.



QTY REQD	ITEM NO.	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
-1					

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL. ON FRACTIONS — DEC — ANGLES —	J CONNELLY DRAWN BY 12 27 65 DATE	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204
MATERIAL B 1149939	CHECKED BY DATE; APPROVED BY DATE; CONTRACT NO	MAGNET, PLATED
FINISH NOTE-3		SIZE B; CODE IDENT NO. 23667; 1149941
		SCALE 2/1; SHEET 1 OF 1

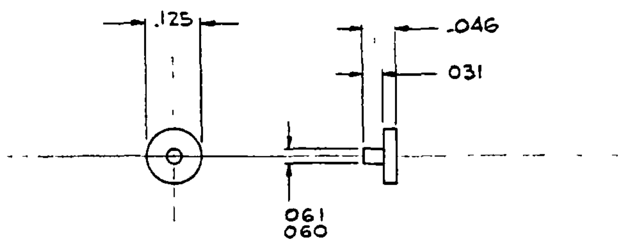
3024-063

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS DEC ANGLES ±.010 ±.005	MARTIN 3 31 66 DRAWN BY DATE CHECKED BY DATE APPROVED BY DATE CONTRACT NO	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204
MATERIAL STAINLESS STEEL TYPE 303		BUSHING, BEAM
FINISH PASSIVATE		SIZE B · CODE IDENT NO 23667 · 1149942
		SCALE 4/1 · SHEET

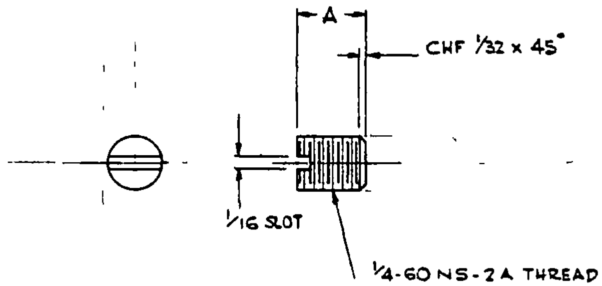
3024 1½

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



PART Nº	DIM A
1149943-1	5/16
1149943 2	7/16

QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
-1					

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS ±.010 DEC – ANGLES ±5°

MATERIAL ALUM BRONZE GRADE 18

FINISH

DRAWN BY MARTIN DATE 4 5 66

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO.

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204

SCREW, CALIBRATION STOP

SIZE B | CODE IDENT NO. 23667 | 1149943

SCALE 2/1 | SHEET

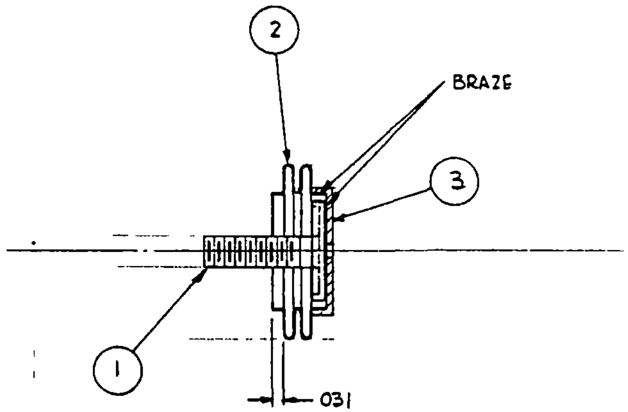
3024-19

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO.	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
1	3	B	1149934	CAP, SCREW	
1	2		153214	BELLOWS (MODIFIED)	
1	1	B	1149933	SCREW CENTER	
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL. ON FRACTIONS DEC ANGLES ±.005

MATERIAL

FINISH

DRAWN BY MARTIN DATE 4 1 66

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204

SCREW ASSEMBLY

SIZE	CODE IDENT NO.	
B	23667	1149945

SCALE 2/1 SHEET

3024-07

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.

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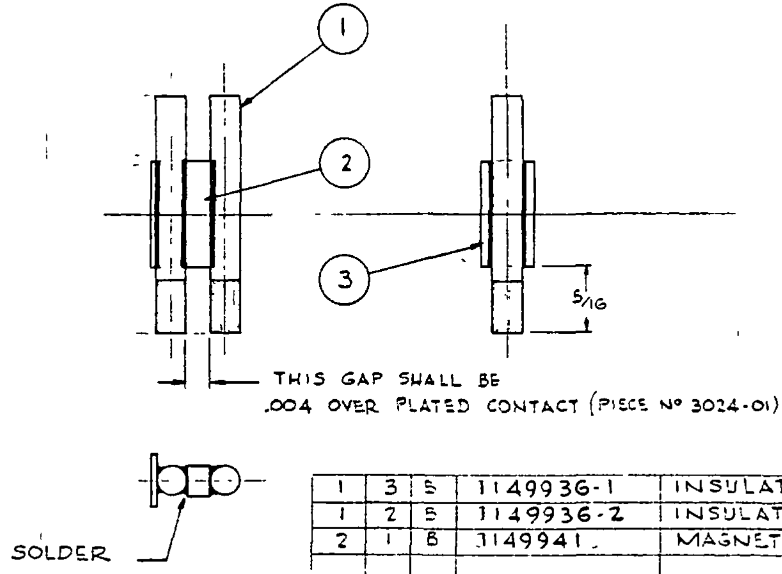


1	3	B	1149936-1	INSULATOR	
1	2	B	1149936-2	INSULATOR	
2	1	B	1149941	MAGNET, PLATED	
QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM ARE IN INCHES. TOL ON FRACTIONS DEC ANGLES	DRAWN BY MARTIN DATE 4 '63	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE MARYLAND 21204
	CHECKED BY DATE	
MATERIAL	APPROVED BY DATE	CONTACT ASSEMBLY
	CONTRACT NO	
FINISH		SIZE B · CODE IDENT NO. 23667 · 1149952
		SCALE 2/1 · SHEET

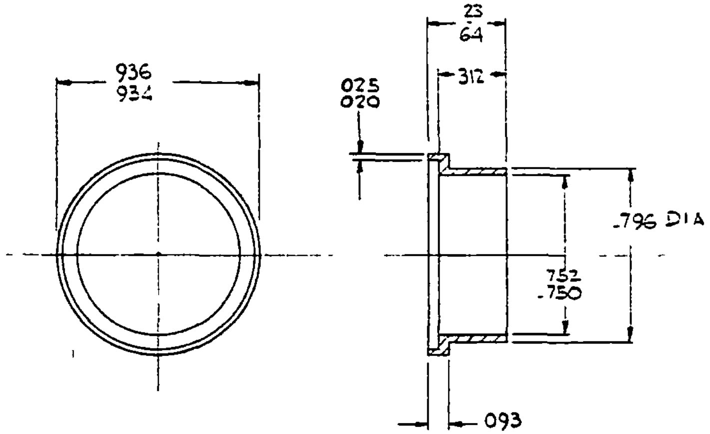
3024 06

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES.

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS DEC ANGLES ±010 ±005 —	MARTIN DRAWN BY 3-31-66 DATE CHECKED BY DATE APPROVED BY DATE CONTRACT NO	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE MARYLAND 21204
MATERIAL STAINLESS STEEL TYPE 304		BUSHING COVER
FINISH PASSIVATE		SIZE B | CODE IDENT NO 23667 | 1149953
		SCALE 2/1 | SHEET

3024-03

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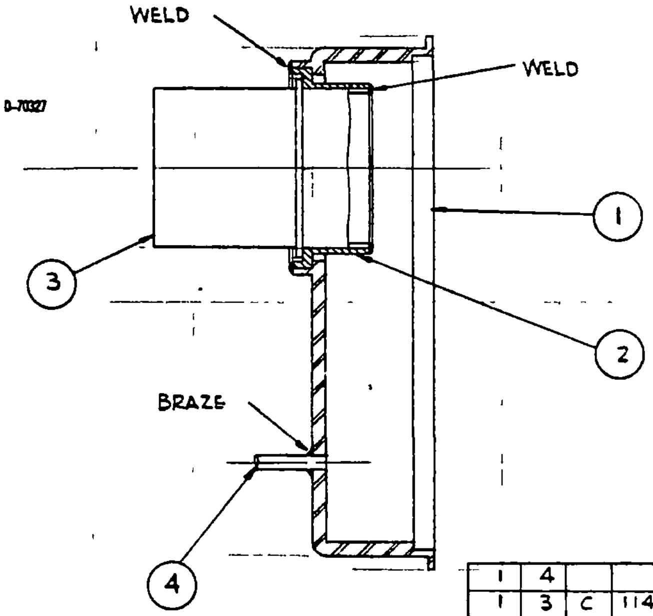
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO.	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
1	4			TUBING, COPPER .062 OD	
1	3	C	1149410-1	CONNECTOR	
1	2	B	1149953	BUSHING COVER	
1	1	C	1149960	COVER	
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS DEC ANGLES	DRAWN BY MARTIN DATE 4-1 66	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204
MATERIAL	CHECKED BY DATE	COVER ASSEMBLY
	APPROVED BY DATE	
	CONTRACT NO.	SIZE B CODE IDENT NO. 23667 1149954
FINISH		SCALE 2/1 SHEET

3024-02

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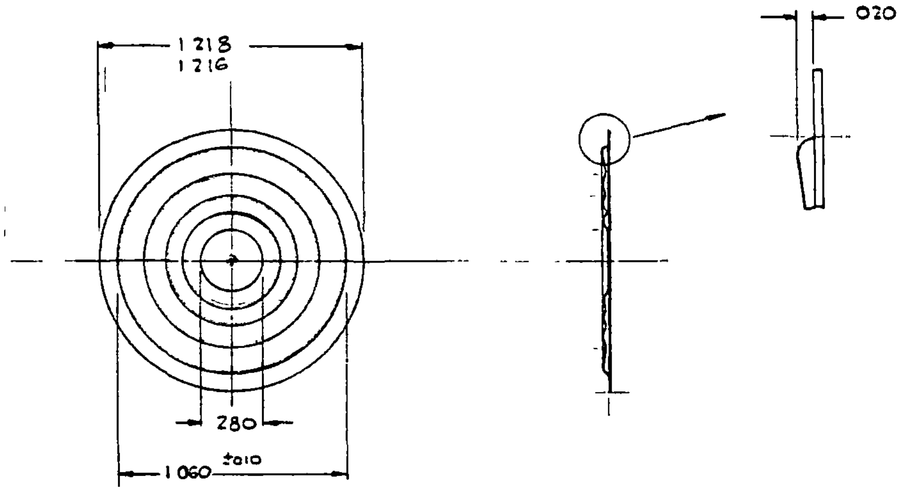
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM ARE IN INCHES. TOL ON FRACTIONS DEC ANGLES
±005

MATERIAL
009 NI SPAN C

FINISH

DRAWN BY MARTIN DATE 4-5-66

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION
BALTIMORE MARYLAND 21204

DIAPHRAGM, CALIBRATION STOP

SIZE B | CODE IDENT NO. 23667 | 1149955

SCALE 2/1 | SHEET

3024 21

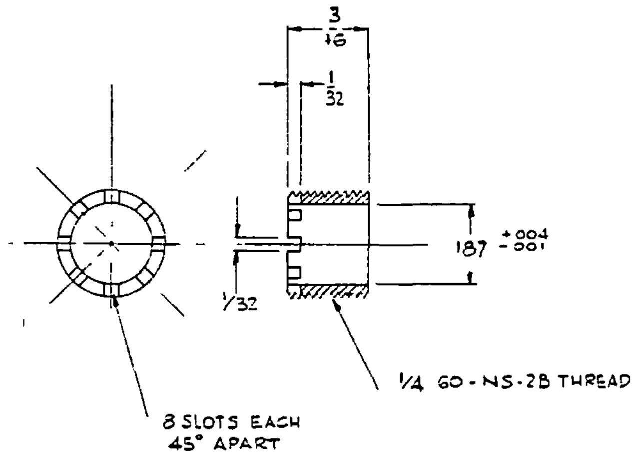
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.

THIS DRAWING IS FURNISHED FOR ENGINEERING INFORMATION AND REFERENCE ONLY. THE FURNISHING OF THIS DRAWING DOES NOT CONVEY ANY REPRODUCTION OR MANUFACTURING RIGHTS



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS ±.010 DEC - ANGLES ±3°	DRAWN BY MARTIN DATE 4 5 53	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE MARYLAND 21204
MATERIAL ALUM BRONZE GRADE 18	CHECKED BY DATE APPROVED BY DATE CONTRACT NO	STOP SCREW, DIAFHRAGM
FINISH		SIZE B CODE IDENT NO 23667 1149956
		SCALE 4/1 SHEET

3024-20

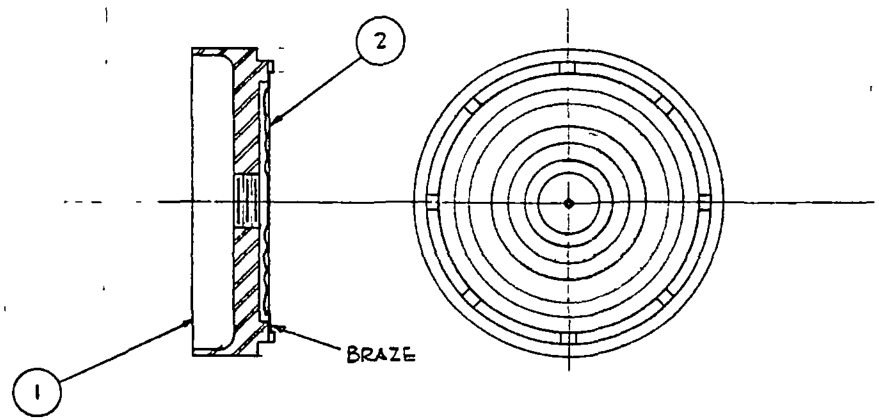
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.

THIS DRAWING IS FURNISHED FOR ENGINEERING INFORMATION AND REFERENCE ONLY. THE FURNISHING OF THIS DRAWING DOES NOT CONVEY ANY REPRODUCTION OR MANUFACTURING RIGHTS



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
1	2	B	1149955	DIAPHRAGM CALIBRATION STOP	
1	1	B	1149958	PLATE DIAPHRAGM	
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL. ON FRACTIONS DEC ANGLES	MARTIN 4-3-65 DRAWN BY DATE	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204
MATERIAL	CHECKED BY DATE APPROVED BY DATE CONTRACT NO	PLATE ASSEMBLY, DIAPHRAGM
FINISH		SIZE B · CODE IDENT NO 23667 · 1149957
		SCALE 2/1 · SHEET

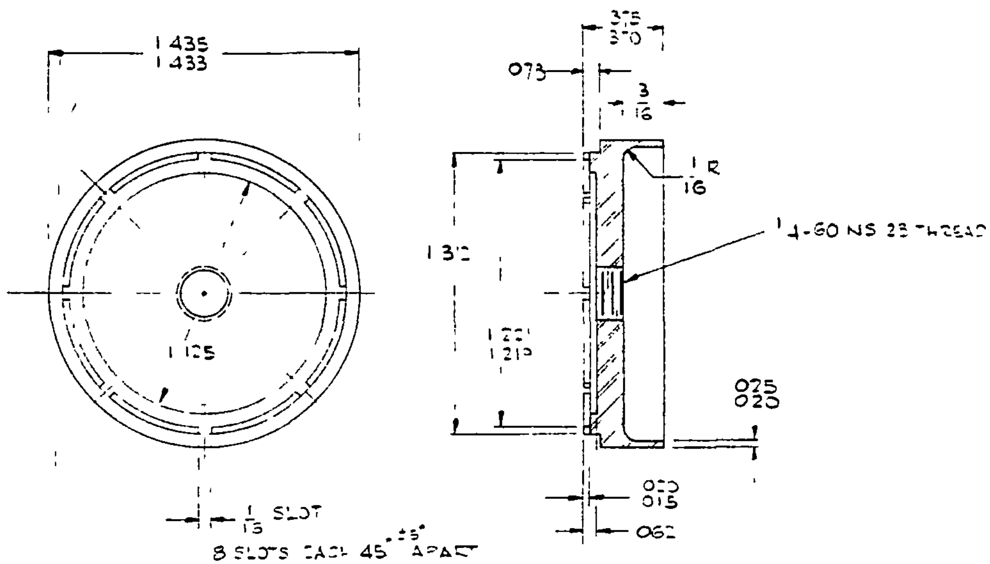
3024-16

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES:

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

UNLESS OTHERWISE SPECIFIED DIM. ARE IN INCHES. TOL ON FRACTIONS ±.010 DEC ±.005 ANGLES -

MATERIAL STAINLESS STEEL TYPE 304

FINISH PASSIVATE

DRAWN BY MARTIN DATE 3-3-

CHECKED BY DATE

APPROVED BY DATE

CONTRACT NO.

THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204

PLATE DIAPHRAGM

SIZE	CODE IDENT NO	
B	23667	1149958

SCALE 2/1 SHEET

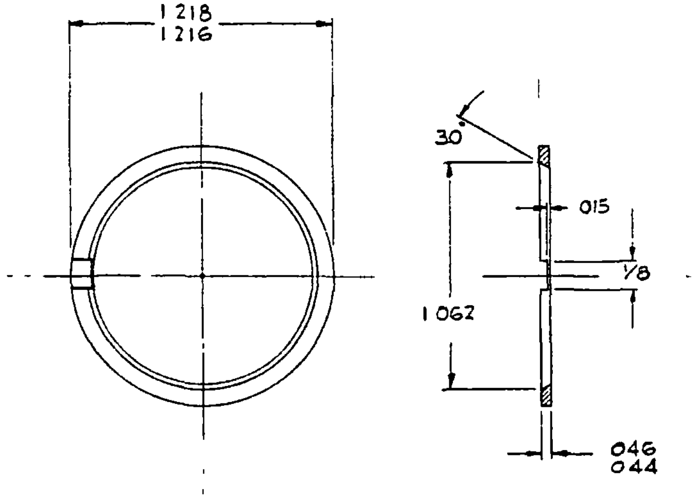
3024-17

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES.

1—INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327

2—PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING.



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	NOTES
-1	LIST OF MATERIAL OR PARTS LIST				

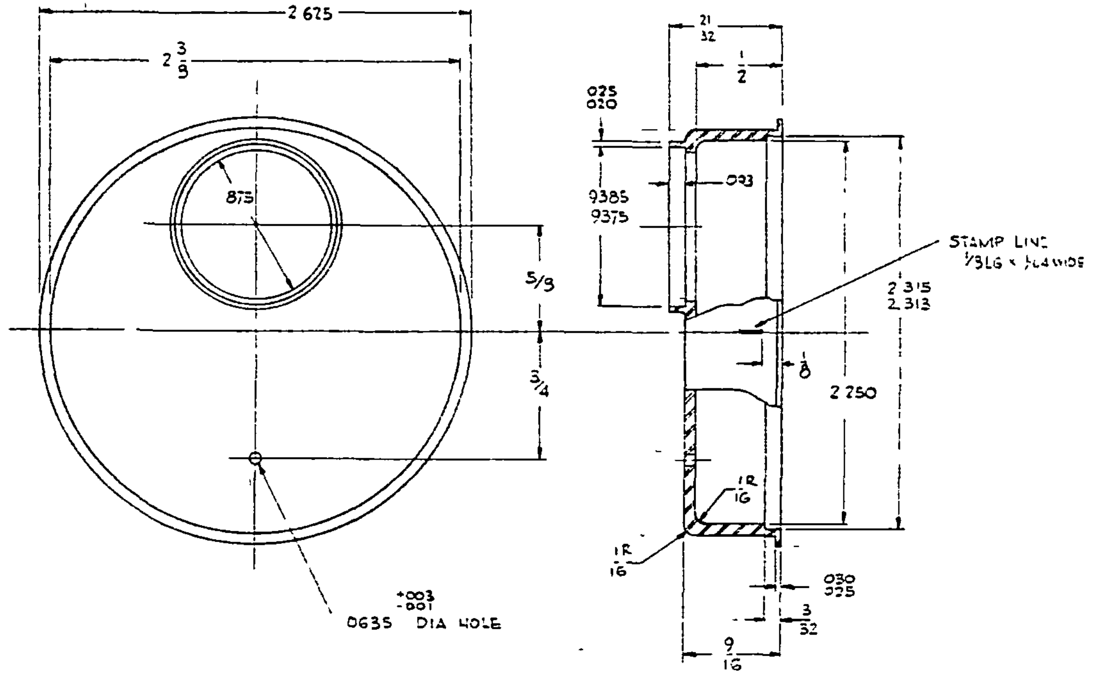
UNLESS OTHERWISE SPECIFIED DIM ARE IN INCHES. TOL ON FRACTIONS - DEC ±005 ANGLES ±5	MARTIN DRAWN BY — 4 1 65 DATE	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE MARYLAND 21204
MATERIAL STAINLESS STEEL TYPE 304	CHECKED BY — DATE; APPROVED BY — DATE; CONTRACT NO	SPACER DIAPHRAGM
FINISH PASSIVATE		SIZE B — CODE IDENT NO. 23667 — 1149959
		SCALE 3/1 — SHEET

3024-11

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

NOTES

1. INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D-70327
2. PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTES
1						

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES ±.010 ±.005 –	DRAWN BY MARTIN DATE 3-21-63	THE Bendix CORPORATION • FRIEZ INSTRUMENT DIVISION BALTIMORE, MARYLAND 21204
	CHECKED BY DATE	
	APPROVED BY DATE	COVER
MATERIAL STAINLESS STEEL TYPE 301	CONTRACT NO	
FINISH PASSIVATE		SIZE C CODE IDENT NO 23667 1149960
		SCALE 2/1 SHEET

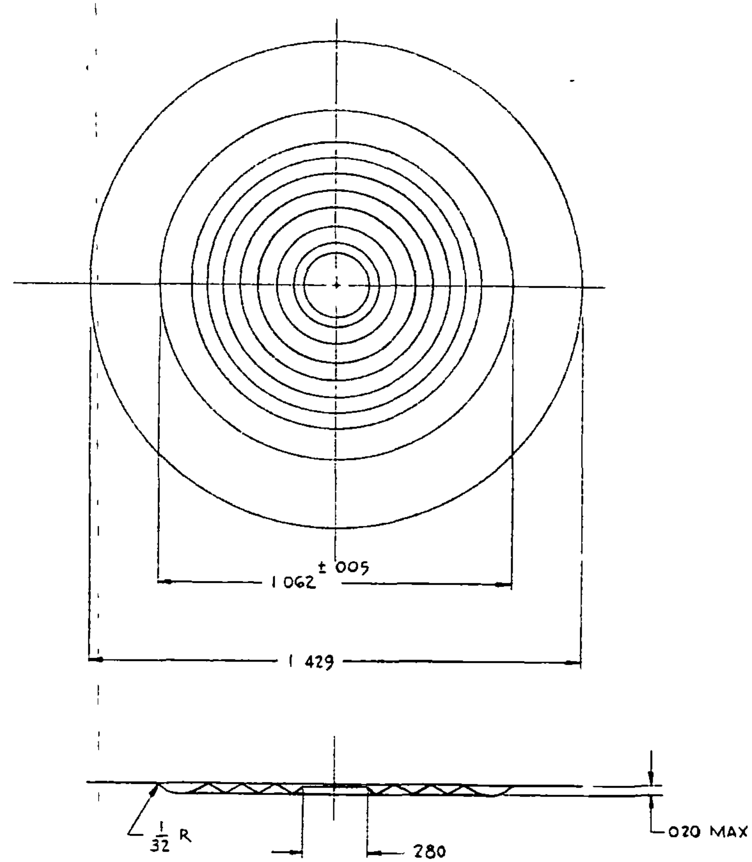
3024.04

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	A	NEW DRAWING	12 9 65	
	B	REVISED	4 12 66	

NOTES

1 INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS PRESCRIBED BY MIL D 70327

2 PLATED PARTS MUST MEET SPECIFIED TOLERANCES AFTER PLATING



QTY REQD	ITEM NO	DWG SIZE	PART OR IDENTIFYING NO	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	NOTES
1						

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES

MATERIAL 001 THK NI SPAN-C

FINISH

J CONNELLY — DRAWN BY — 12 9 65 DATE

CHECKED BY — DATE

APPROVED BY — DATE

CONTRACT NO

THE Bendix CORPORATION FRIEZ INSTRUMENT DIVISION BALTIMORE MARYLAND 21204

DIAPHRAGM, CALIBRATION

SIZE C — CODE IDENT NO 23667 — 1149961

SCALE 4/1 — SHEET 1 OF 1

3024-044